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TELEVISION — COMMUNICATIONS — SERVICE — SOUND

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HARRY H. TOMBS LTD, THE WINGFIELD PRESS, WELLINGTON

CONTROL OF TELEVISION BROADCASTING

Almost before this issue appears in print, the General Election will have been decided, so that we hope no one who thinks that a journal of this nature should keep itself aloof from political considerations will accuse us of attempting to affect the issue. However, there is one plank in the policy of the National Party which will be of much interest to the radio industry, if only in a somewhat indirect way. We refer, of course, to National's expressed intention to establish a television commission to administer TV broadcasting in New Zealand, as distinct from the Labour Party's policy of making a Government department responsible for it.

It might seem to some that in these two approaches we have a distinction without any real difference, but this is not so. A department of state is responsible from day to day, not to Parliament, but to a Minister of the Crown, which is a very different matter. A public corporation, set up by the Government for a specific purpose like this one, would be responsible only to Parliament, and within the terms of reference of its charter, would be completely free to carry on its work without reference to a particular person, who, by the nature of things, is always a politician who for the time being, happens to be a member of the party in power. What then, are the advantages, if any, of having a great public undertaking divorced from direct political control?

Those who favour this system consider that there is less likelihood of the undertaking being used for party political ends rather than just for the good of the whole community, regardless of political affiliations. In many public services, there is little or no possibility of such discriminatory action being taken, simply because these services do not in any case lend themselves to it. For instance, it is difficult to see how any political party could make improper use in this way of the post and telegraph services, or the supplying of electricity to the country.

Broadcasting and television, however, come into a different category. They are instruments of communication, as are newspapers and books, and as such, are able to wield enormous influence on the opinions and thought of everyone. There is thus always present the possibility that some Government may make improper use of these media for political purposes, if, as is the present case with broadcasting, they are in direct control of a minister of state. Such use, should it occur, could be construed only as a gross infringement on the civil liberties of the public; it therefore seems a good argument to many people that radio and television should be freed from direct political control.

Another argument that is raised in favour of an independent control authority is that ministerial control tends to stifle free discussion in the media concerned, of controversial issues. There is no doubt that controversial matters should be discussed freely on the radio and on television, no less than they are in the newspapers, in magazines, and in books. Any system of control which prevents such discussion, it is argued, is a bad thing, for no problem is ever solved by not bringing it out into the open.

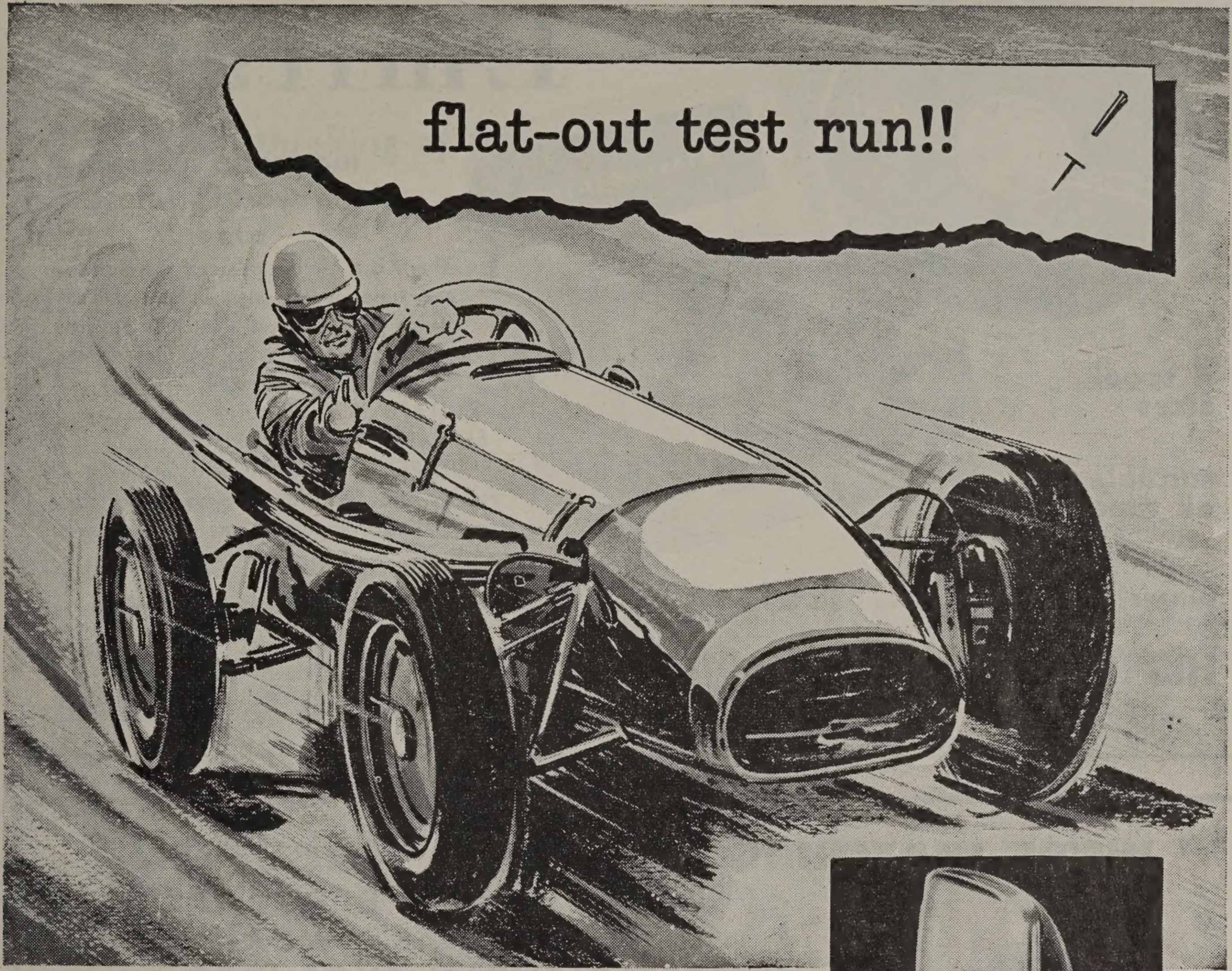
We think that here, the protagonists of independent control have a strong point. Allied to it is that when public communications like radio and TV are in the hands of a Government department, departmental policy may have to suffer a reversal every three years, and the continuity of development of a major public undertaking can therefore be lost. If a public corporation, responsible to Parliament, is in control, and if its charter has to be renewed only after a considerably longer period than three years, development can continue along the lines decided by the corporation over the whole period of its charter, if not quite regardless, certainly much more independently of the political situation from time to time.

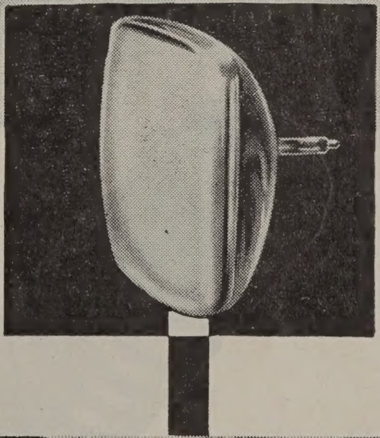
There is no doubt that the National Party's policy will find wide support among the electorate, but it does seem a pity that their policy is not consistent to the extent of including radio broadcasting. If there is a case for television broadcasting to be controlled by a public corporation, there is an equal one for altering the control of radio broadcasting in a similar way. We do not suggest that the two should necessarily be combined, but such a system would work, as in Britain, the B.B.C. have shown.

It seems that in New Zealand we are unfortunately much less conscious of civil rights and liberties than we should be. We are prepared to let broadcasting be run by the Government, directly, without worrying either about the principle of the thing, or about the possible consequences. In Britain, however, public thought is not so malleable. There, when the question arose of instituting a commercial TV service, alongside the non-commercial one run by the B.B.C., it was considered that a new authority, separate not only from political control, but even from the B.B.C. should be set up, and this was in fact done when the Independent Television Authority was established. This typifies the exact opposite of our own approach, where the majority of our people seem to think that "it can't matter less" as long as the Government is providing the service. Perhaps it is merely an illustration of the extent to which the idea of the welfare state has succeeded in colouring our thoughts on these matters.

It is for this reason that we are pleased to see at least one section of the community taking a new line on television control, even though that policy could well be extended as we have suggested.

And what about the entry of private enterprise into the field of television transmission? The National Party's policy does not exclude it, but they hardly appear to have had the full courage of their convictions in the matter, because the question has been notable by its absence so far!





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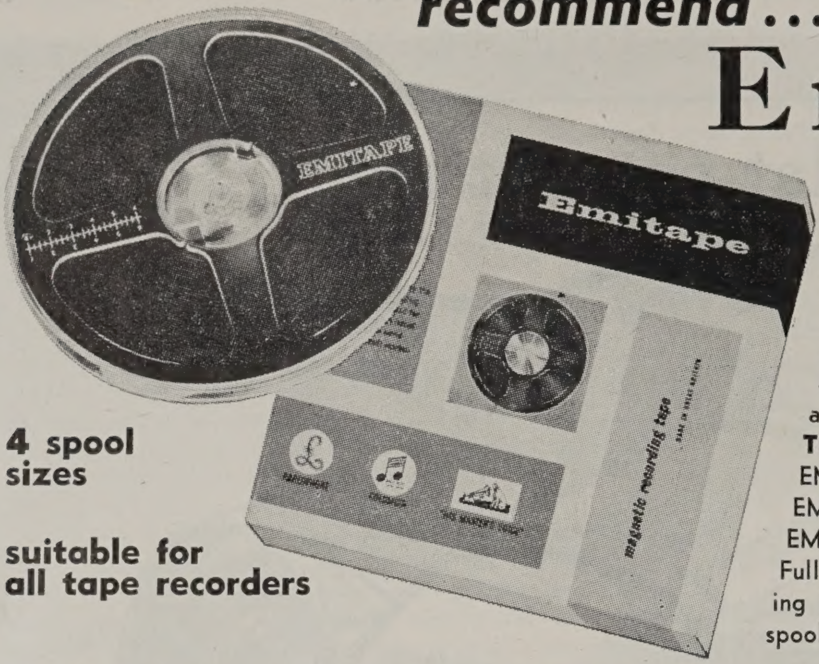

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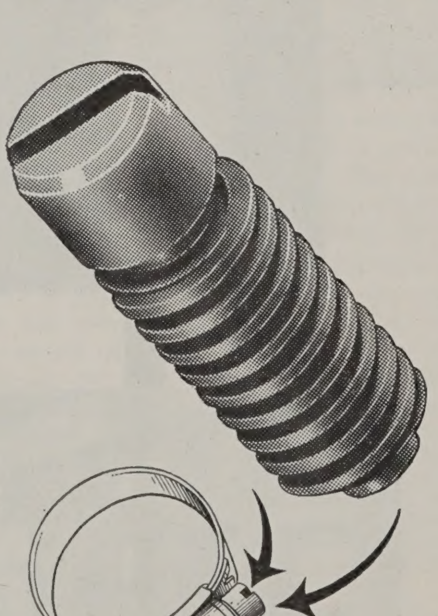

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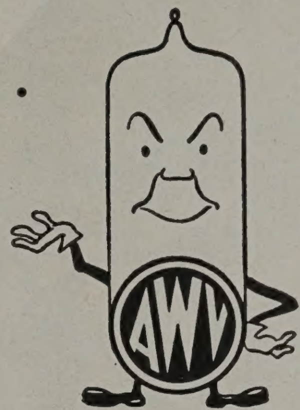
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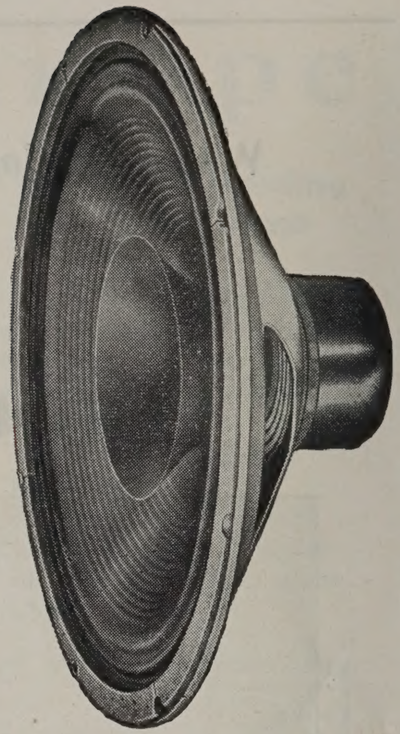

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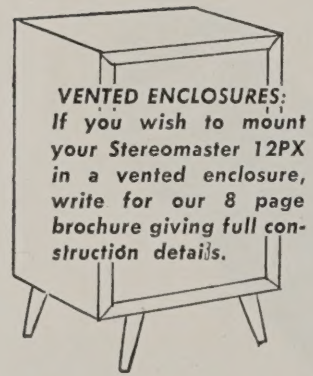

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Introduction

One of the most frustrating of the small difficulties that beset the experimenter is to find (and how often it happens!) that the power supply one has available for testing a new circuit has just too much or too little output voltage. When it is the latter, it is much worse, because nothing short of a different supply will fix matters. The obvious way out of the difficulty is to have a permanent variable-voltage supply on the bench, but circuits for such supplies are not easy to find, and they are usually allied to rather complex regulating arrangements which may or may not be needed for the job in hand. Moreover, most regulated supplies are designed for a fixed-output voltage, or for a limited range of voltages, which makes their utility for general purposes decidedly less than is desirable. The simple circuit described in this article gives a supply that can be varied from about 50 volts to 400 volts, at will, and which will deliver up to 200 ma. at any voltage within its working range. Furthermore, when the voltage is low and the current high, the small output voltage and power are not obtained at the cost of dissipating the rest of which the supply is capable, through high-wattage resistors or through a number of regulating valves.

Principle of the Supply

This happy state of affairs is brought about by using thyratons in a full-wave rectifier circuit. Now, a more long-winded name for the thyraton is the grid-controlled rectifier, and it is the grid-controlled feature of these valves that makes the present circuit a practical one. The essential feature of a thyraton is that if its control grid is made negative with respect to its cathode by more than a certain fraction of the potential applied to its anode, it will not conduct. Thus, if the anode is supplied with A.C., and an exactly out-of-phase voltage at the same frequency is simultaneously applied to the control grid, no conduction will take place if the grid signal is larger than a certain fixed proportion of the anode voltage. Under these conditions, the power supply would deliver no output at all. However, if during all or part of the cycle, the grid voltage is such as to allow the valve to conduct, there is output, and the amount of output depends on the size of the portion of the cycle during which the valve is allowed to conduct. Now, in attempting to use such valves as controlled rectifiers, it is of little use to control the amplitude of the grid voltage. If this is tried, it will be found that only a "bang-bang" type of control is achieved. That is to say, the output is either maximum or zero. Such a scheme could be used for remote stand-by switching, but for little else. If, however, the phase of the grid

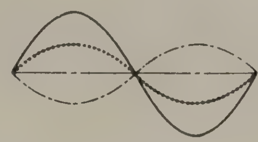


FIG 1

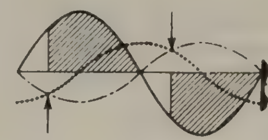


FIG 2

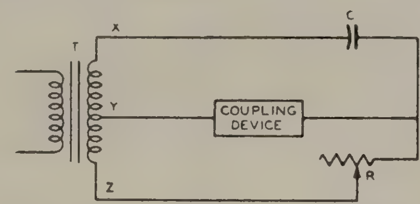


FIG. 3

Control characteristics of thyratron tubes and a basic phase controlling network.

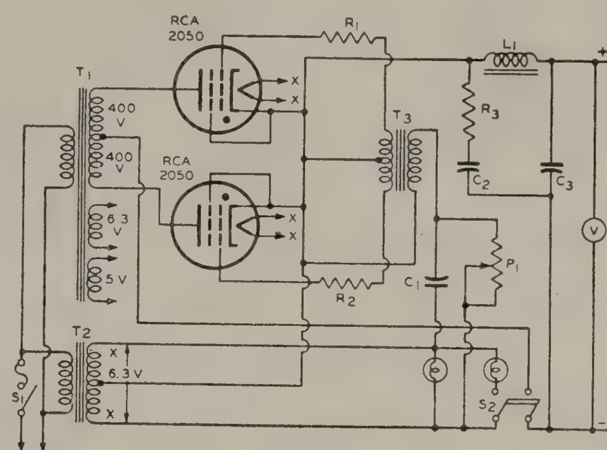


FIG 4

Fig. 4.—Power supply schematic.

Parts List

T_1, power transformer, 400 volts-a-side, up to 200 ma. capacity.

T_2, filament transformer, 6.3 volts, 1.2 amps.

T_3, see text.

C_1, 8 μf. 150 v. electro (higher rating can be used if desired.

C_2, C_3, 8 μf. 450 v. working electro.

R_1, R_2, 100 k. 1 watt carbon.

R_3, 390 ohms (approx.) 25 watt wire-bound.

P_1, 10 k. wire-wound potentiometer.

L_1, smoothing choke, 200 ma., approx. 10 henries.

voltage is varied, then we are able to control the length of time in each cycle, for which the rectifier conducts. This obviously will vary the effective D.C. output voltage of the supply, and does, in fact, represent the principle on which this supply works.

In Fig. 1 we have drawn, in full line, one cycle of anode voltage applied to one of a pair of valves in a full-wave circuit. The dashed line represents an out-of-phase grid voltage, known as the *critical grid voltage*, and this is just sufficient to keep the valve from conducting, during the left-hand half-cycle, in which the anode is positive. During the other half-cycle, there is no conduction because the anode is negative with respect to its cathode anyway.

In Fig. 1, there is also a dotted line showing the grid voltage as in phase with the anode voltage. If the valve is operated in this manner, it is able to conduct for the whole of the positive half-cycle, and still, of course, not at all during the negative half-cycle of anode voltage.

In Fig. 2, the full line again shows the anode voltage over a cycle, the dashed line shows the critical grid voltage, and the dotted line shows the actual grid voltage when the latter is 90° out of phase with the anode voltage. At the spot indicated by the arrow, the valve suddenly starts to conduct, and does so until the anode voltage passes through zero volts. Thus, the cross-hatched portion of the positive half-cycle shows the time during which the valve is able to conduct. On the negative half-cycle for the valve we are considering, the other valve is able to conduct, so that Fig. 2 shows the conduction that takes place during one whole mains cycle, owing to the full-wave connection of the two rectifiers. The area of the hatched portion, compared with that of a complete cycle, provides a measure of the actual output voltage as against that obtained when the rectifiers conduct for the full half-cycle each.

The Grid-phasing Circuit

The principle of this part of the circuit is shown in Fig. 3. A transformer T has a centre-tapped secondary winding connected to the coupling device. If the centre-tap Y is used as a reference point, the voltage on one side, at X, is, of course, 180° out of phase with the voltage on the other side, Z. Then, if the resistance R is high compared with the reactance of the condenser C, the coupling device is effectively connected across the upper half of the secondary, XY, and the voltage across it is in that phase. But if the resistance is low compared with the reactance of C, the coupling device is effectively across the lower half of the secondary, YZ, and the voltage across it is now in opposite phase. In this position, the condenser C is connected across the whole secondary, XZ, but since its reactance is high compared with that of the transformer secondary, the current can only be small, and no ill effects take place. Intermediate values of resistance will give phase differences intermediate between the extremes just described, and will give output voltage control that is so desirable a feature of the supply.

Constructional Details

Figure 4 shows the complete circuit of the adjustable supply. A separate 6.3 volt filament transformer is used to light the filaments of the rectifiers, and the pilot lamps, and to supply the phasing voltage for the grids of the thyratons, through the transformer T_3. The latter is an ordinary inter-stage audio transformer intended for working a pair of push-pull grids from a single driver valve, and can have a ratio of 1:2 overall.

The resistor R_3 is essential, and should on no account be omitted. It is there to limit the peak current drawn by the 2050s to a safe value, and requires a high wattage rating because of the high ripple current passed by the first electrolytic condenser.

C_1 is the phasing condenser, and has been specified as an elertolytic in spite of its having a small A.C. voltage applied to it. This voltage cannot rise higher than 6.3 volts, and at this the capacity of the condenser is the same in either direction, and no harm can come to it.

The two switches are necessary because the H.T. supply to the 2050s must on no account be applied until these valves have had 30 seconds or so to warm up. S_2 is a double-pole switch in order to allow it to bring in a second pilot light, indicating the H.T. is on.

Adjusting the Phasing Transformer

It should be evident from the description of the circuit that T_3 must have its secondary properly phased. All that is needed to do this is to set the R_1 to maximum resistance, and ensure that this is the setting that gives minimum or zero output from the supply. If this is initially found not to be so, the leads of the secondary of T_3 should be reversed.

Technology

AN INTRODUCTION TO TELEMETRY

Part 4—R.F. Transmitters and Aerials

Once the various measurements have been made by transducers, and these have each modulated one of the standard I.R.I.G. sub-carriers, all of these must simultaneously modulate a radio frequency transmitter. This is a somewhat more difficult job than may at first appear, because the modulation must be accomplished in an extremely linear or distortionless manner. If it is not, there will be cross-modulation, or cross-talk, between the various sub-carriers. This is similar in effect to the cross-talk that occurs in carrier telephony, through which output from one channel is heard, either as intelligible speech, or as unintelligible "monkey-chatter" on one or more of the other channels. In telemetry, cross-talk is important because it can degrade the signal-to-noise ratio of a channel, and if bad enough, can actually spoil the measurements being made by the channel that suffers from the cross-talk. If modulation could be accomplished in an extremely linear manner—which is the same thing as saying in a manner which produces negligible distortion of the sub-carriers—cross-talk would be non-existent. In practice, of course, no modulation method is entirely free from distortion, so that harmonics of the sub-carriers are produced. These may interfere directly with another sub-carrier, or they may beat with harmonics of another sub-carrier, to produce interference to yet a third channel. The first step in preventing cross-talk is the mixing of the sub-carriers in very linear circuits which are sometimes called harmonic-suppression filters.

USING THE MISSILE ITSELF AS A SENDING ANTENNA

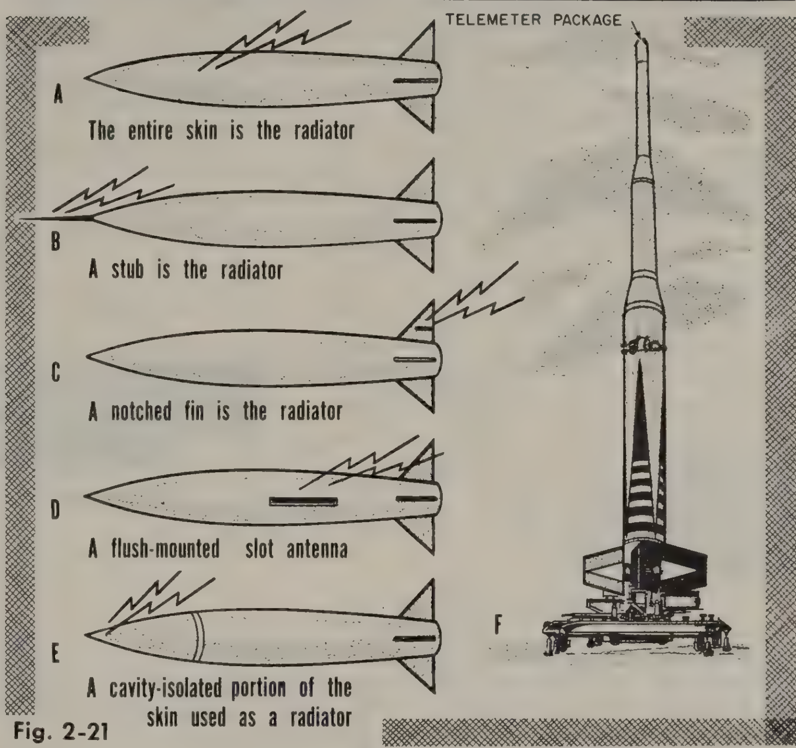


Fig. 2-21

In achieving distortionless modulation, the type of modulation is most important. The sub-carriers could amplitude-modulate the R.F. carrier, but A.M. has several disadvantages for telemetry work. First, it is difficult to obtain linear enough A.M. over the extremely wide frequency range covered by the standard sub-carriers. Secondly, if a number of sub-carriers have to be used, each can only be allowed a fractional percentage modulation, and this in turn means that the signal-to-noise ratio achieved in each channel is only a fraction of what it would be if only one channel were able to modulate the carrier 100%. A further disadvantage of A.M. is that signal fading adversely affects the measurements.

As a result, the R.F. carrier in telemetry is almost always frequency- or phase-modulated by the sub-carriers. Even here, special precautions must be taken, because in order to preserve equal signal-to-noise ratios in all channels, the high-frequency ones must give greater deviation than the low-frequency ones. Further, the deviation of the low-frequency channels must be kept small in order to avoid cross-talk. However, using phase or frequency modulation does enable a large number of sub-carriers to be accommodated on the one main carrier.

Operating Ranges

The operating range of a telemetry system depends on a number of factors, all of equal importance.

(1) Transmitter power.
(2) Receiver sensitivity.
(3) Receiving aerial gain.
(4) Transmitting aerial gain.

With the aerial systems generally in use for telemetry, a transmitter power of 3 watts will give

about 50 miles effective range. Greater ranges are frequently obtained by using high-powered R.F. amplifiers giving outputs of 40 to 50 watts.

The problems associated with the R.F. portion of telemetry transmitters are similar to those that are found with the remainder of the equipment, namely ruggedness, compactness, and dependability. High-powered circuits in the restricted space available in a missile pose the additional problem of dissipating the heat generated, so that forced-air or even oil-immersion cooling have to be resorted to. Vibration and shock make it difficult to design the circuits in such a way that frequency-modulations of an undesired nature do not occur, and frequency drift is a problem too, owing to the high temperatures inside the missile itself. Only components of the most advanced design and construction can be used for these purposes, so that the cost of the equipment bears little or no relation to its small size and often deceptively simple appearance.

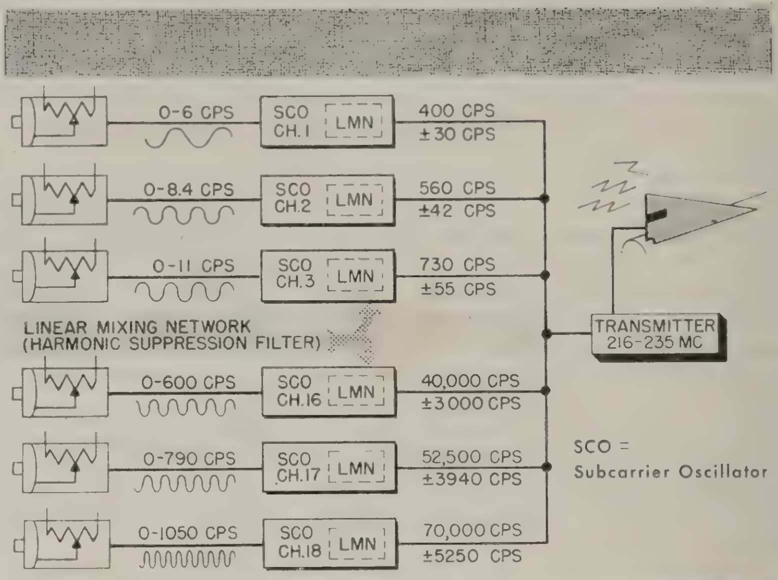


Fig. 3-1 FREQUENCY-DIVISION MULTIPLEXING. AN FM-FM SYSTEM

Transmitting Aerials

Since the power output of telemetry transmitters is small, the most efficient possible transmitting aerials must be used. Unfortunately, however, there are many difficulties in the way of making an efficient aerial in or on a missile. Chief of these is that the missile cannot have any appendages hung round it, as did older and slower aircraft. The missile's streamlined shape must be preserved at all costs. Then again, the missile may be spinning on its longitudinal axis like a rifle bullet, so that only one aerial would result in fluctuation of signal strength at a rate equal to the rotation speed of the missile. The solution to this problem is to arrange for several aerials, so disposed that their combined polar diagram in a plane at right-angles to the axis of the missile is circular, or approximately so.

These and other difficulties are overcome in practice by making the missile itself act as the radiator of R.F., or by making some part of it perform the same function. Possibilities that have all been used are:

(1) Using the whole airframe as the radiator.

(2) Using short stubs or wires which have little wind resistance while the missile is inside the earth's atmosphere.

(3) Using a fin, or other part of the vehicle which itself projects from the main body as a radiator.

(4) Slot radiators, such as are used in modern high-speed aeroplanes. These slots can be flush with the outer skin of the airframe, and so offer no wind resistance at all.

(5) A resonant cavity can be used to electrically isolate portion of the vehicle so that it can be used as an aerial.

Those possibilities are illustrated in Fig. 2-21. At A is shown the use of the entire surface of the missile, while B illustrates a nose spike that can be used as an aerial, as well as for other purposes, such as a pilot head for airspeed measurements. At C we have a notch in one fin, which enables the fin to act as a radiator at ultra-high frequencies. D shows a slot, which in practice would be one of an array arranged, as mentioned above, to give a circular radiation pattern. At E is a cavity-isolated nose portion of the missile—a system which is actually used in the X-17 missile illustrated in F. The cavity isolator enables the construction of the missile to be all metal, and makes the mechanical design easier to accomplish satisfactorily, as the cavity is part of the construction. Sometimes, more than one transmitter is used, in which case two or more of these aerial types can be used simultaneously, or else, a single wide-band aerial is used, and fed from both transmitters at once by means of a diplexer.

Power Supplies for Missile Transmitters

Most often, electronic equipment in a missile has its own power supplies, that are quite independent of the vehicle's propulsion motors. This allows the continued transmission of data even though the propulsion motors are finished with, or have failed prematurely. Various types of power supply are used, but once again, their

prime requirement is reliability. Dynamotors, producing high voltage D.C. from low-voltage batteries are often used. For short-term applications, special leak-proof lead-acid accumulators of miniature size are used to run the dynamotors. Special dry cells, similar to ordinary carbon-zinc dry cells are also used, as are modern alkaline accumulators, such as silver-zinc and nickel-cadmium cells.

Instead of dynamotors, motor-generators providing 110 volts at 400 cycles per second are often used, as these provide the flexibility inherent in alternating current supplies, while the relatively high frequency makes iron-cored components such as power transformers small and light compared with their 50-cycle counterparts. Whatever the type of power supply used, regulation is always applied so that frequency drift of sub-carriers can be minimized.

Multiplexing

Most telemetry systems have to transmit information on a large number of variables simultaneously, and these articles so far as they have gone have indicated one method by which a single R.F. carrier can be made to bear several different pieces of information at once. This is the use of a number (actually up to 18 in the standard telemetry system) of sub-carriers. This is technically known as *frequency multiplexing*.

There is another method which may be used, and this is known as *time multiplexing*. This scheme involves the use of trains of pulses, each of which is modulated in some way, together with a synchronizing pulse which enables a particular train of pulses to be selected at the receiving end, without interference from the other trains. Thus, several trains of pulses may be used at one time to modulate a single sub-carrier, before it in turn modulates the R.F. carrier.

In this way, the amount of information carried by a single R.F. transmitter may be vastly increased, and because of the rather wide variety of ways in which pulse trains themselves can be modulated with the primary information, there is almost no limit to the complexity of a complete telemetry system. Fig. 3-1 shows the basic system of frequency-division multiplexing. This is called an FM-FM system, because the two modulation methods are both FM. This is to say that each sub-carrier is frequency-modulated by the primary information from its transducer, and then, after the modulated sub-carriers have been mixed in the linear network referred to earlier, the combination is used to frequency-modulate the R.F. carrier.

Types of Pulse Modulation

When a train of pulses is to be modulated, there are a number of possibilities for doing this. The pulses can be amplitude-modulated, frequency-moulated, length-modulated, or position-modulated. The first two methods, of course, are familiar, and are able to be used with sinusoidal carriers as well as with trains of pulses, but the last two can only be applied to pulse trains. Telemetry systems are specified by a series of letters, as illustrated for some of the possibilities in the accompanying table.

Limitations of Frequency-Multiplexing

While frequency-multiplexing is very useful, and is always used in modern telemetry systems, it has the limitation that each sub-carrier is able to carry the

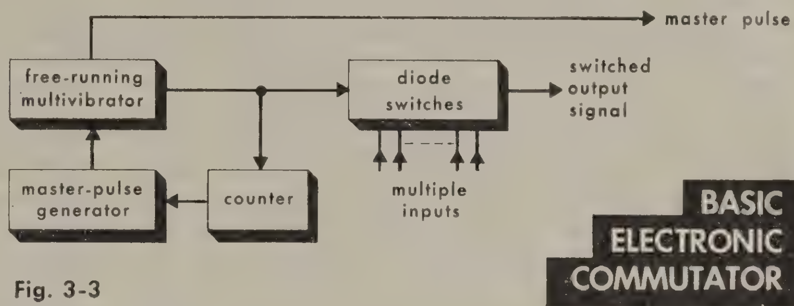


Fig. 3-3

TELEMETRY-SYSTEM TERMINOLOGY

Name of System	*First 3 Letters Type Of Multiplex (How Signal Is Applied to Subcarrier Oscillator When Used)*	*Middle 2 Letters Type of Subcarrier Modulation (When Subcarrier Oscillator is Used)*	*Last 2 Letters Carrier Modulation*
PAM-FM-FM	Pulse Amplitude Modulation	Frequency Modulation	Frequency Modulation
PAM-FM-PM	" " "	" "	Phase Modulation
PAM-FM-AM	" " "	" "	Amplitude Modulation
PAM-FM	" " "		Frequency Modulation
PAM-PM	" " "		Phase Modulation
PAM-AM	" " "		Amplitude Modulation
PDM-FM-FM	Pulse Duration Modulation	Frequency Modulation	Frequency Modulation
PDM-FM-PM	" " "	" "	Phase Modulation
PDM-FM-AM	" " "	" "	Amplitude Modulation
PDM-FM	" " "		Frequency Modulation
PDM-PM	" " "		Phase Modulation
PDM-AM	" " "		Amplitude Modulation

modulation due to only one transducer. Time-multiplexing, as already described, gets over this difficulty by allowing several transducers to modulate one sub-carrier in such a way that at the receiving end, the signal due to each transducer can be separated from that of all the others. Time-multiplexing is inherently a switching method. Instead of allowing the output of a transducer to modulate its sub-carrier continuously, the transducer is switched to the sub-carrier modulating circuit for brief periods only. These periods can be looked upon as sample periods, during which the transducer output is used, separated by much longer periods, during which the transducer's output

is ignored. These longer periods are then available for sampling the output of one or more other transducers. Thus, the available time is split up into small packets, during which the outputs from a number of sources are successively sampled. When all have been sampled once, the system returns to the first, and repeats the sampling cycle all over again.

To take a specific example, let us suppose that we have three transducers, and that their outputs are varying only at a very slow rate. Because this is so, sampling the output of each transducer at intervals that are short compared with the rate at which the information is changing will enable us at the receiving end to build up a quite accurate picture of the original variations in the transducer output. Suppose, for example, that the highest frequency in the output of the transducer is only 25 cycles per second. Then, if we take sample readings at intervals of, say, one two-fiftieth of a second, we can be sure that no sudden changes occur between one sampling and the next, and therefore that by taking only these brief readings, we have not lost any essential information. Each sample could last for only a few microseconds, therefore, so let us say that the sampling period lasts for 100 microseconds, and takes place every 250th of a second. This means that between every two samplings of the first transducer, we have a free space of 900 microseconds.

Sampling A Signal

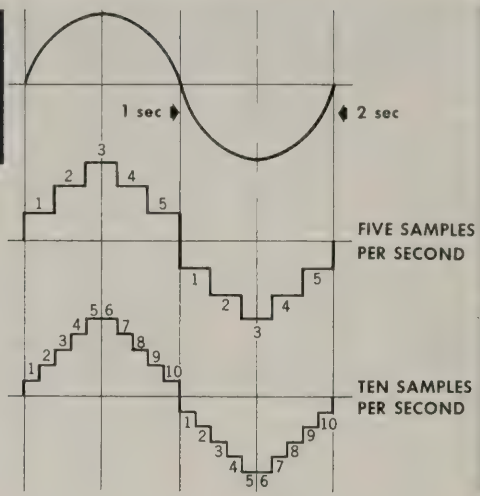


Fig. 3-4

Next, we arrange that 150 microseconds after each sample from the first transducer, we take a sample from the second. We are now sampling two transducers, each at a rate of one sample every 250th of a second, and we still have a space of 650 microseconds between the end of each sample from No. 2 transducer, and the beginning of each sample from No. 1. This time could be used to accommodate two more 100 microsecond sampling periods, so that when we add together all four trains of pulses, we will have what looks like a single train at four times the original rate, i.e., at 1000 per second. Provided we can think of some means of separating the four different trains of sampling pulses at the receiving end, we can now use the combined train to modulate a single sub-carrier, which in turn modulates the R.F. transmitter.

SIMPLIFIED EXAMPLE OF TIME-DIVISION MULTIPLEXING OF THREE SIGNALS

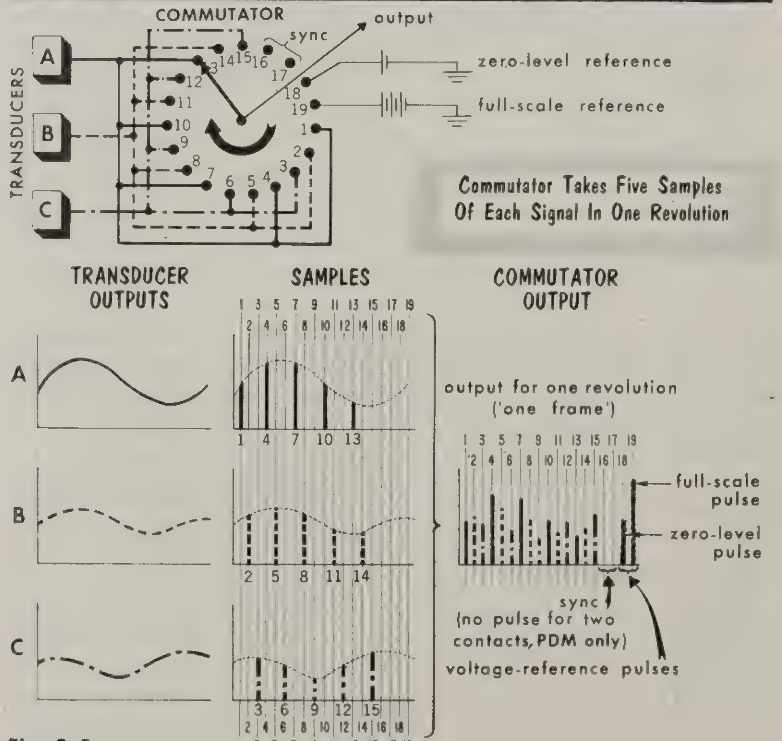


Fig. 3-5

To give an idea of how this can be done, we can imagine a scheme in which the separate trains of pulses are all amplitude-modulated, but one train is left unmodulated, and of much larger amplitude than that reached by any of the other trains. At the receiver, the large pulses could be separated from the rest by a clipping circuit, much as the synchronizing pulses in a television signal are separated from the video information. The separated pulses can then be used as a synchronizing signal which enables gating circuits to separate the other three trains of pulses, after which their modulation, representing the original behaviour of their own transducers, can easily be

(*Concluded on page* 37)

BOOK REVIEWS

Video Tape Recording, by Julian Bernstein, published by John F. Rider, Publisher, Inc., New York.

It is not often that a new development in electronics is followed so soon after the event as was the commercial application of video tape recording by this one. At the outset we should say that this is not one of the valuable but small paper-backs for which Rider is justly famous. It is a cloth-bound volume of over 250 pages, excellently printed and produced, and covering its subject in a manner that will give it a very wide appeal among technicians and engineers.

The book is not a design treatise, full of the advanced mathematics that one tends to associate with such texts, but is of a descriptive nature, and obviously intended for those who expect to deal with these complex and extremely precise machines. The author has included chapters on waveforms and television techniques in general, in the hope that these will make the subsequent exposition readable by non-technical people, such as producers, and other television production staff. It is doubtful, however, whether he will have succeeded in this aim. For engineers and advanced technicians, however, the book will be a most informative and useful one. Profusely illustrated with half-tone reproductions of parts of the actual Ampex and R.C.A. video tape recorders that are in use today, it sets out the somewhat complex system that has to be used in a very clear and readable manner. Illustrations are given showing the picture effects of maladjustments and tape faults of various kinds, and later in the book, a selection is given of some of the rather unusual circuits that are to be found in the recorders. In the space that can be allotted to a review of this kind there is no room to even outline the mechanism by which video tape recording works. There is no doubt, however, that its successful accomplishment is a major engineering triumph, or that these machines will find themselves in increasing use every day, in spite of their high initial cost. It is interesting to note, too, that in spite of the great speed of the rotating heads across the tape, the bandwidth that can be directly recorded is still much too small to allow a video signal to be directly recorded as such. Bandwidth compression is undertaken by means of a vestigial sideband modulation process, followed by demodulation during playback. The linear speed of the tape is only 15 inches per second, and difficulties due to wow and flutter are overcome by recording along one edge of the tape a control signal which causes the speed fluctuations which remain after recording has taken place, to be exactly followed by the mechanism when the tape is played back. It is interesting, too, to note that the speed-constancy of synchronous motors is by no means good enough, so that variations have to be ironed out by means of a very high-gain servo control of the motor speed. The problems that the engineers have had to overcome to bring video tape to an acceptable pitch of performance are truly formidable both in scope and number, and the complexity of the whole machine reflects this fact. As a result, those operating them must need a far greater knowledge of the principles and designed features of the equipment than is required for most electronic gear, not excluding studio television equipment. This is no doubt the reason for the publication of this book at such an early stage in the development of the video recording art. The author and publisher are to be congratulated on an excellent text, which should find ready acceptance throughout the television industry the world over.

Television Explained, by W. E. Miller, M.A.(Cantab.), M.Brit.I.R.E., revised by E. A. W. Spreadbury, M. Brit.I.R.E. Published by Iliffe & Sons, London.

This journal is constantly being asked to recommend suitable text-books for initial television study, and we have no hesitation in advising readers who are looking for such a book to get this one. First published in 1947, under the authorship of Mr W. E. Miller, the book has run through six previous editions, so successful did it turn out to be. The last of these was re-written by Mr Spreadbury because of the considerable number of changes in domestic receiver technique that had come about since 1947. and sold out so rapidly that the present, seventh edition was put into production.

The book assumes a knowledge of ordinary sound radio receiving practice, but no prior knowledge of television. It is simply and readably written, in descriptive fashion and without mathematics, and is comprehensively illustrated with diagrams and photographs. No one need be put off by the fact that it is written in Britain, and refers mostly to the British 405-line television standard. The fact is that all modern standards are merely modifications of this one, with such detailed alterations as the use of F.M. sound instead of A.M., and negative modulation instead of positive. After having digested the somewhat deceptively large amount of information in this book, the avid learner will no doubt want to progress to more advanced texts, and to books filled with samples of the rather more complex circuitry that is to be found in America and European TV receivers. At the outset, however, he would be well advised to buy this one, and use it, before going on to more advanced texts.

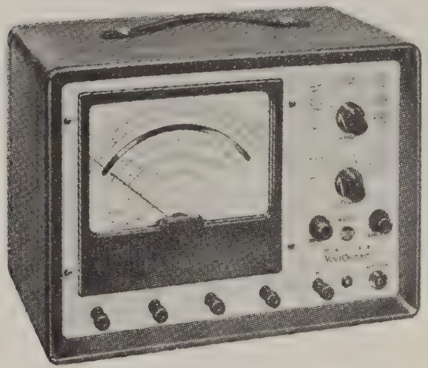
Transistor Projects, by the staff of the Gernsback Library.

This is one of the well-known Gernsback paper-backed radio publications designed specifically for the

(*Continued on page* 37)

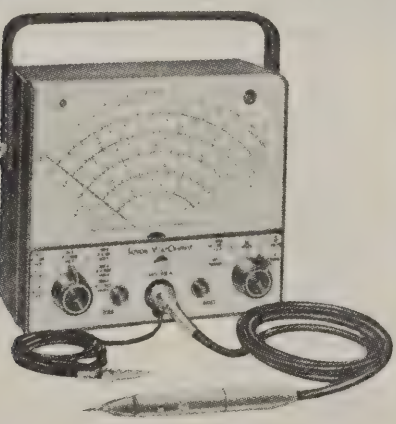
TELEVISION

MASTER VOLTOHMYST WV87B



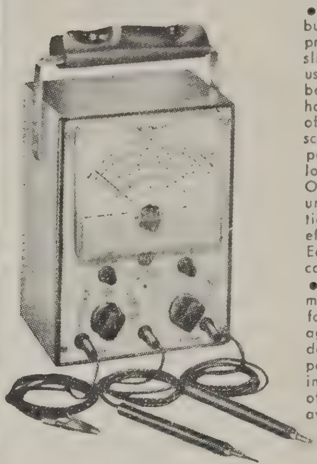
The WV-87B Master VoltOhymst is a de luxe instrument useful for television, radar and other types of pulse work. It has facilities for the direct measurement, on separate scales, of peak-to-peak voltage values of complex wave forms and the rms voltage values of sine waves. It also reads dc voltage resistance, and direct current. Vacuum tubes are employed in all functions except current measurement to ensure excellent sensitivity and stability.

SENIOR VOLTOHMYST WV98A



The WV-98A Senior VoltOhmyst provides direct peak-to-peak measurement of complex wave shapes up to 1400 volts and is especially useful for television signal tracing and industrial servicing. Quantitative measurements of practically all of the important complex waveform voltages found in video, sync and deflection circuits can be obtained with the instrument. The WV-98A has such refinements as seven non-skip ranges on all functions, wide frequency range and extended voltage range. It is provided with Type WG-299B DC/AC Ohms Probe and shielded cable. Available as accessories are a slip-on crystal probe, WG-301A, which permits rms measurement in r.f. circuits up to 250 mc, a high voltage probe, type WG-289, and a multiplier resistor, WG-206, which extended the dc voltage range of the instrument to 50,000 volts, and multiples all scales by 100 times.

A NEW RCA VOLTOHMYST WV77E(K)



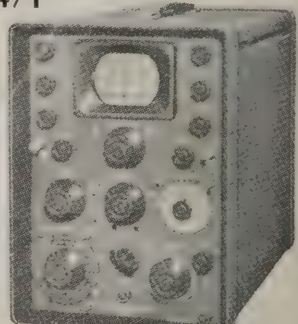
• The easiest to assemble VTVM ever. • Meter electronically protected against burnout-PLUS-ohms-divider network fuse-protected. Unit is burnout proof! • Ultra-slim probes and flexible leads—easy to use in those tight spots. • Cables can be stored in plastic holder attached to handle, for increased portability! Plenty of room for power cord too. • Separate scales for $1\frac{1}{2}$ volts rms and 4 volts peak-to-peak ensure rated accuracy on low ac readings. • Famous RCA Volt-Ohmyst circuit means excellent stability under conditions of line voltage fluctuation—PLUS—special circuit to minimise effects of contact potential change. • Easier, faster to read scales—meter colour coded to match range switch. • Extra rugged 400 microampere meter movement. • Case completely shielded for protection against r.f. fields. • Voltage divider networks use 1% tolerance deposited carbon resistors. • Front panel is brushed aluminium—all lettering is acid etched to last the lifetime of the unit. • Both wired and kit unit available.

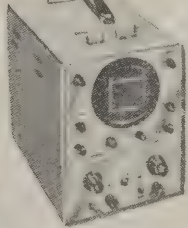
MARCONI TV ALIGNMENT OSCILLOSCOPE TF1104/1

The TF1104/1 is designed primarily for frequency response measurements on television and f.m. receivers operating in v.h.f. bands 1, 11, and 111.

It comprises a frequency-swept generator for connection to the input of the r.f., i.f., or video stages of the receiver, and a c.r.o., synchronised to the sweep frequency, for viewing the receiver output. Internally generated calibration 'pips', can be superimposed on the display, enabling tuning and bandwidth adjustments.

Other important applications include the adjustment of discriminators in f.m. receivers and the matching of aerials to transmission lines. Can also be used as a conventional oscilloscope.





WO-33A (K) OSCILLOSCOPE

Whether you're a ham, an Electronics hobbyist, a TV Technician, or an engineer the new WO-33A (K) Oscilloscope will help you solve those tough servicing problems. Here's a 'scope that's good for PA work—so sensitive you'll get a clear trace display from the lowest level pickups, microphones, and other low level electronic equipment. It has gain comparable to an aural-visual signal tracer and is the only 'scope available that gives you high gain and excellent bandwidth at such an economical price and compact size.

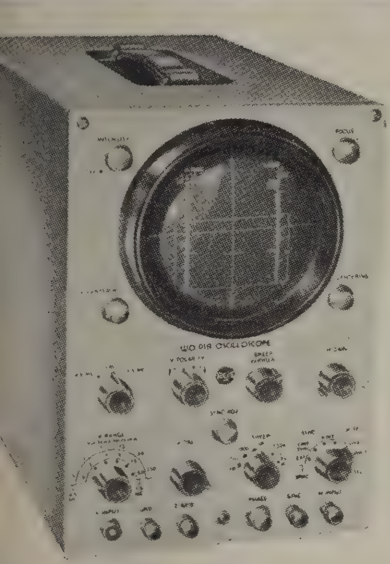
The WO-33A (K) can be used in PA systems servicing, radio troubleshooting general servicing and alignment work in black and white and colour TV applications.

VERTICAL AMPLIFIER: Wide band position Sensitivity—100 rms millivolts/inch
Bandwidth—within –3db, 5.5 cps to 5.5 Mc.
Narrow band position Sensitivity—3 rms millivolts/inch
Bandwidth—within –3db, 20 cps to 150 Kc.

SWEEP CIRCUIT: Sawtooth range—15 cps to 75 Kc. Sync—external + internal
Line sweep—160° adjustable phase. Sync range—to 4.5 Mc.

VERTICAL CIRCUIT INPUT IMPEDANCE:
At Lo-Cap Cable Input—10 megohms, 10 micromicrofarads (approx.)

SERVICING



RCA WO-91A

The WO-91A is a new, low-cost, 5 inch oscilloscope designed for use in production and servicing of both black and white, and colour TV sets. Essential for trouble shooting in chrominance circuits, the WO-91A can be used to observe and measure colour-burst signals and is equally useful for signal tracing and aligning wide band video amplifiers. The WO-91A is equipped with a multi-scale graph screen, scaled directly in volts for all scales, which makes direct measurement of peak-to-peak voltages as easy as with a VTVM.

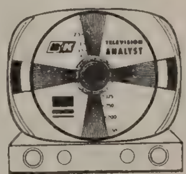
CHOICE OF WIDE-BAND OR HIGH-SENSITIVITY OPERATION:
A front panel switch gives the user a choice of wide-band or narrow-band (high sensitivity) operation of the vertical amplifier.
Frequency response: (reference frequency 10 kc) Wide-band position, within ± 1 db from 10 cps to 4.5 Mc; Narrow within ± 6 db at 1.5 Mc.
Sensitivity: 0.05 peak-to-peak volt per inch (0.018 rms volt) in narrow band position: 0.15 peak-to-peak volt per inch (0.053 rms volt in wide-band position).

CA MULTIMETER WV38A(K)

Volt-Ohm-Multimeter has special ranges for transistor plications. You'll do a more professional servicing job h this highly accurate, versatile and stable VOM—a world ster from the world leader in electronics. Never so many uable features packed into a VOM. Ohms-divider, net-k fuse-protected. Easy-to-read scales. Extra-large 5¼ inch er. Polarity reversal switch. Improved frequency response. l-wave bridge rectifier. Less circuit loading. Standard n ranges. PLUS—modern styling—it's an instrument you'll proud to show off in home or shop. New handle clips ommodate probes and test leads for extra carrying con-ience. Extra 1-volt and 0.25 volt (25 Omv) dc ranges servicing transistor equipment.

B & K TV ANALYST

Tests each stage separately and you watch the results on the TV set itself. Unique, point-to-point signal-injection technique makes TV trouble shooting quick, direct, easier and more profitable. With the remarkable B & K Model 1075 TELEVISION ANALYST, you can accurately isolate any faulty stage and quickly diagnose any TV troubles. No external 'scope is needed. By use of the generated test pattern you can actually see the resultant condition directly on the picture tube of the television set itself. You can easily trouble shoot and signal trace any stage throughout the video, audio, r.f., i.f., sync, and sweep sections of black and white and colour television sets. Model 1075 is supplied complete with standard test pattern, white dot white line crosshatch and colour bar pattern slide transparencies and one clear acetate. Complete with cables.



PRICE LIST

TYPE No.	DESCRIPTION	PRICE
WO-33 (K)	3″ Oscilloscope kit	£49
WO-33	3″ Oscilloscope wired	£69
WO-91a	5″ Cathode-Ray Oscilloscope	£115
B & K	Analyst	£150
TF1104/1	Marconi TV Sweep Generator	£198
WV-77e	Junior Voltohmyst	£25
WV-77e(K)	Junior Voltohmyst Kit	£19.15
WV-87b	Master Voltohmyst	£63
WV-98a	Senior Voltohmyst 230v.	£35.10
WV-38a(K)	Multimeter kit	£19.10
WV-38a	Multimeter wired	£22
R.C.A. ACCESSORIES		
WG-206	Probe	£3. 3
WG-216b	Low Capacitance Probe	£3.18
WG-220	Direct Probe & Cable	£2. 6
WG-264	Crystal Diode Probe	£4. 9
WG-289	High Voltage Probe and Resistor	£6.18.6
WG-291	Demodulator Probe	£4. 9
WG-293	Low Capacitance Probe	£4. 4
WG-295	Video Marker	£14.18
WG-299c	DC/AC ohms Probe and Cable	£4.17.9
WG-300b	Direct/Low Capacitance Probe and Cable	£7.18
WG-301a	Crystal Diode Probe	£4. 7.9
WG-302a	RF/IF/VF Signal Tracing Probe	£4.19

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AN "ELECTRONIC B BATTERY" USING TRANSISTORS

D.C. to D.C. transistor converters are becoming increasingly used for a wide range of power outputs, and now that there are available high-powered transistors and silicon rectifiers, hundreds of watts can be handled in this way. The present article shows how practical experience with these circuits can be gained by building a small unit which provides 60 volts at 5 ma. or more. This can be put to useful work in powering the valves of a hybrid valve-transistor portable receiver.

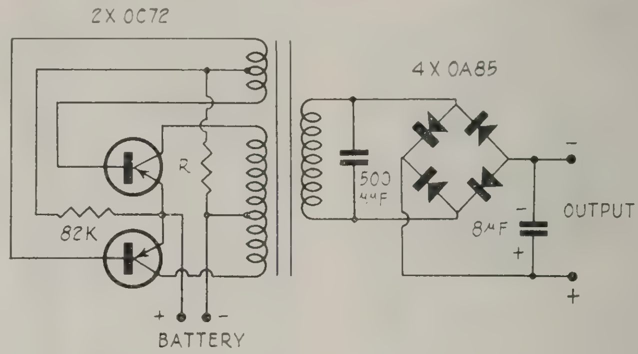
Introduction

The D.C. to D.C. transistor converter is assuming considerable practical importance these days, because of its high efficiency, and because transistors have developed to the point where it is no longer difficult to handle quite high wattages in this way. Suitable core materials are now available in this country, such as H.C.R. alloy and ferrites, like Ferroxcube. In addition, their design is not difficult once the magnetic properties of the core materials are known, and the predicted performance is easily obtained. In order to gain experience in the design of these units, our laboratory has built a small example, suitable for replacing a 67½-volt battery in portable valve-operated equipment. The experiment was so successful that we have written this short description of the unit in order to encourage others who might wish to build similar ones for themselves. Over a quite wide range of output current, the regulation is good, and the input-to-output efficiency is between 79 and 80 per cent. The unit as built would make an excellent one for powering a valve-operated "front end" of a hybrid set using a transistor audio amplifier, or it would be eminently suitable for supply B power to a radio-control receiver normally powered from a B battery that is much larger and heavier than the "electronic" version.

The power supply itself weighs just under 3 ounces, as against twelve for the battery it replaces, and occupies less than a quarter of the space that the battery would use. Actual measurements are 2½ in. x 2½ in. x ⅞ in. The supply was designed in this case for an input of 3 volts, at which it draws only 120 ma. at its full output. Further, the power output can be increased without spoiling the efficiency, simply by increasing the forward bias on the transistors slightly.

Circuit of the Converter

The converter is of the push-pull saturating core type, the heart of which is the transformer. This must be wound so that the peak collector current of each transistor is able to take the core to saturation, which it does once in each cycle of the square-wave oscillation that is set up as a result of the phasing of the base windings, in relation to the collector windings. At the end of each half-cycle of the oscillation, the energy built up in the inductance of the transformer is "poured" into the filter condenser by the full-wave rectifier circuit, and, owing to the reduction in the rate of change of the collector current, when the transistor "bottoms", the voltage in the primary and base windings of the transformer reverses, causing a regenerative switching action to take place, which very rapidly cuts off the conducting transistor and drives the non-conducting one into heavy current. This builds up in a linear fashion, owing to the inductance of the collector winding, until the other transistor bottoms, and the circuit switches back to the first transistor again.



Circuit of the converter, which has been designed to give an output of 60 volts, nominally, at current drains up to 8 ma. The text shows how different output voltages can be obtained and how the basic design can be modified to use different battery voltages. The unit described uses a battery of 3 volts.

It is essential in this circuit that the rectification be full-wave, so that either a bridge rectifier must be used, as here, or else a centre-tapped output winding with a conventional bi-phase rectifier must be used. In this converter the first scheme was used because the voltages wound have been too high to allow a pair of OA85s to be used. The bridge circuit places the output voltage across two of the rectifiers in series, and thus halves the peak inverse voltage applied to each.

The oscillation frequency is approximately 2000 c/sec., and this is determined by the number of turns, and therefore the inductance of the collector windings. Smoothing is effected by means of the 8 μfd. condenser filter at the output, while the small condenser across the output winding of the transformer prevents high peak voltages from developing and being applied to the collectors and bases of the transistors, thus endangering them.

Practical Details

The transformer for this supply is a Ferroxcube core, type D25/16/10/3B3, and can be obtained from E.D.A.C. Ltd. Wellington. It is provided with end plates and a small polystyrene bobbin on which to put the windings.

The primary (collector) winding consists of 48 turns, centre-tapped, wound with 32-gauge enamelled wire. The base winding has eight turns, centre-tapped, wound with 38-gauge wire. The high-voltage winding has 540 turns of 38-gauge wire.

The primary winding is wound in bifilar fashion, by winding the two halves simultaneously, with two wires at once. Twenty-four turns of the double wire are put on, making 48 in all, and this just fills two layers on the bobbin, bringing the finish out to the same side as the start. A layer of paper is put on, and then, at the slot side of the bobbin, the base winding is put on, again in bifilar fashion, as four double turns. Before proceeding to put on the high-voltage winding, the start and finishing ends of the two windings already put on should be clearly labelled, to facilitate the interconnections that have to be made later.

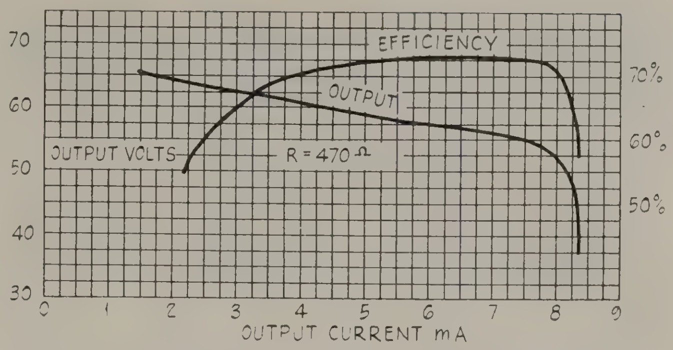
Another layer of paper is put on, after which the 540-turn winding is added.

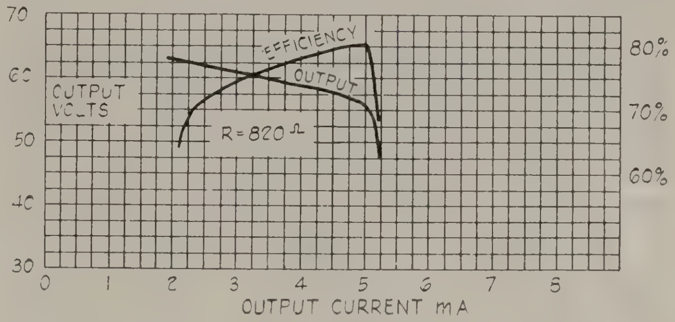
When the winding is finished, bare the four ends belonging to the collector winding, and sort them out, using a continuity tester, labelling them S_1 and S_2, for the starting ends, and F_1 and F_2 for the finishing ends. Bring together through a single piece of sphagetti, ends F_1 and S_2, twisting them lightly together, and soldering the bare ends.

Now identify and connect together F_1 and S_2 of the base winding. Place insulating sleeves over all the remaining windings, using the same colours for the outer ends of the collector winding, and a different colour, but the same for both of the ends of the base winding. A third colour can be used for the ends of the high-voltage winding.

This done, the circuit can be connected up. Initially, do not solder the base winding leads too firmly, since these may have to be reversed after the first try at switching on.

Initially, make R equal to 820 ohms. In wiring up the rectifiers, note that the ends of the OA85s that are marked with a white band represent the cathodes, or the cross-bar ends of the symbols on the drawing, and the unmarked ends on the diodes represent the anodes, or the triangular parts of the symbols. Note, too, that when the four rectifiers are connected up to form the bridge, the A.C. input from the transformer goes to the corners of the bridge where dissimilar ends of the diodes join, while the corners where similar ends join give the D.C. output, in the polarity shown on the diagram. This will enable the 8 μfd. smoothing condenser to be correctly wired without resort to trial and error.





The upper curve shows the performance of the circuit if outputs up to 8 ma. are required. The 3-volt battery drain at maximum output is only 200 ma. The lower pair of curves shows how the circuit performs with a larger value of R, giving a smaller maximum output, but higher efficiency. In this condition the maximum battery drain is about 120 ma.

Initial Testing

When the wiring is complete, get two torch cells and make up a 3-volt battery by connecting them in series. Connect a 12 k. 1 watt resistor across the output terminals, and a voltmeter, on its 0-100 v. range, across the resistor. If one is available, connect an ammeter, measuring 0-250 ma. or more in series with the battery, and switch on. If in switching on, there is no D.C. output, then the circuit is not oscillating, and should be switched off immediately. The only cause of non-oscillation, if the components are correct, is that the phasing of the base winding relative to the collector winding is incorrect. Therefore, either the base leads, or the collector leads should be reversed, BUT NOT BOTH. This done, switching on should have the supply in business. With the 12 k. load, the voltage across it should be about 55, and the input current should be about 120 ma. With the base resistor at 820 ohms, this represents full output from the converter, as reference to the curves will show.

If higher output power at approximately the same voltage is wanted, it can be got simply by dropping the value of R. The second set of curves applies to the case where this has been lowered to 470 ohms. Approximately twice the output power is available at the same voltage as before, but it will be seen that the efficiency has dropped to about 73 per cent. from a maximum of 80 per cent. For a small converter, these figures are very good indeed. If there is any

danger of the converter being switched on without load being applied to it, connect a bleeder resistor of about 56 k. across the output terminals. This prevents the voltage from rising too high at zero output current.

Modifying the Design

If, as may well be the case, the exact arrangement shown here does not meet some special requirement of your own, it is a simple matter to modify it, provided the same Ferroxcube core is used.

Altering Output Voltage

If you want to operate from a 3-volt battery, but need a different output voltage, the collector and base windings remain the same, but the output winding can be scaled according to the new voltage required. It will be noted that the nominal 60 volts output occurs at about half-way along the useful part of the output curve. Thus, if 45 volts is required, three-quarters of the turns are put on the output winding, and the current available at the new voltage will be four-thirds of the current shown on the curve for a 60-volt output. The output voltage and current can be scaled up or down in this way at will, provided that for higher voltages, the wire size is altered to accommodate the larger number of turns on the bobbin. The curves of output current versus output voltage can be scaled simply by multiplying the voltage scale by the required factor, and dividing the current scale by the same factor.

Altering Input Voltage

If the input voltage is to be altered, there are more things to be taken care of. For the new input voltage, the turns on the collector and base windings must be scaled in proportion to the voltage. It is hardly likely that lower input voltages will be wanted, so that if higher ones are to be used, the turns on these windings will go up in proportion, as mentioned. To take a specific case, let us assume that we want the transformer re-designed for a 4½-volt supply. This is 50 per cent. higher than the original 3-volt supply, so the collector winding now has to be 72 turns, tapped at the centre, and the base winding, 12 turns centre-tapped.

The original design stepped up the primary voltage by a factor of 22 to one, or slightly over the nominal 20 to one ratio between the output and input voltages. The increase to 22 from the nominal 20 is due to the fact that when the transistor is bottomed, there is still a small voltage developed across it, so that not quite the full battery voltage is applied across half the collector winding, as there would be if the transistor were a perfect switch. Since the output voltage is to remain at 60, and the input voltage has been raised to 4½, the new ratio of output to input voltage is 14.35 to one. Therefore, increasing this slightly, as was done before, we arrive at a figure of 16 to one step-up from half the collector winding to the output winding. (In this calculation, only half the collector winding is considered, because only one transistor is working at a time.) Since the new collector winding has 36 turns each side, the new output winding will have $36 \times 16 = 576$ turns. A trial transformer can now be wound with the calculated number of turns, and the converter tested. A point to note about this new design is that the peak collector current will be smaller than in the original, in inverse ratio to the input voltages; that is, two-thirds of what it was originally. Thus, as far as the transistors are concerned, they are running lighter than before, and it should be possible to obtain increased power output from the new design without exceeding the peak collector current rating of the transistors. To do this in practice, all we need to do is to leave the base bias resistors at their original values. The higher input voltage will see to it that there is proportionately more forward base bias, and therefore peak current in the transistors as the loading on the converter is increased.

If the original power only is required, the resistor R can be experimentally determined until the output voltage versus output current curve is approximately the same as it was originally. These curves have been drawn here for the original design, and two different values of transistor peak current.

Behaviour of the Converter Under Load

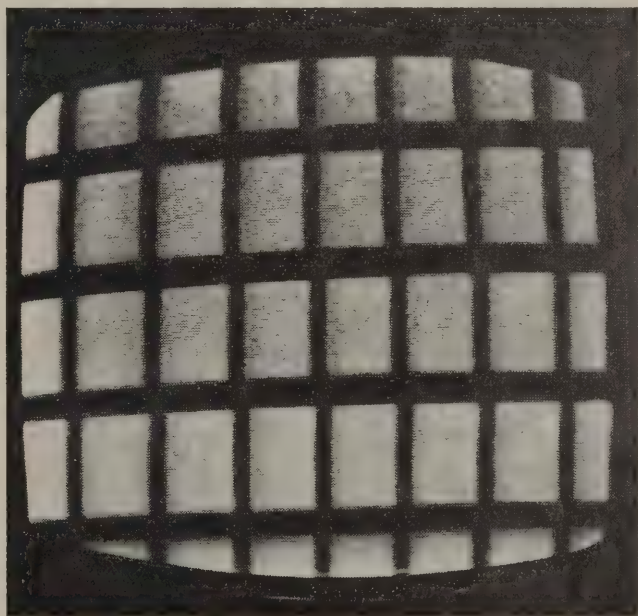
At no load at all (a condition in which the converter should not be operated) the output voltage rises to quite a high value. As a small amount of loading is applied, this drops quickly, and within the working range of the converter, the output voltage is within a few volts either way, of the nominal output voltage. If the input current is measured, it will be found that it increases linearly with the output current. A point is finally reached at which the output current drops rapidly with any further increase of loading, and when this happens, it will be found that the input current has reached a maximum, beyond which it is unable to rise because the base forward bias does not allow the transistors to draw any more. However, if the bias is increased, the transistors are able to go on drawing more and more current as the loading is increased, and the power output is therefore higher too. All this is well illustrated by the two sets of curves shown here. It will be seen too, that at the higher forward bias, the efficiency has dropped by about eight per cent. Thus, there is a very real advantage in running the converter with as little forward bias (or in other words, the highest value of R) that will allow the required maximum current to be drawn from it. This is because the greatest efficiency occurs just at the point where the converter develops maximum output current, and because the smallest amount of input power is drawn at light loading, the smaller the forward bias current. Thus, for a given application, it is a good idea to make R variable, and adjust it to the highest value that will allow the required output current to be obtained.

There is one rather peculiar feature of these converters, namely that the power output obtainable is not strongly dependent on the size of the core. This is because the core must be driven into saturation by the peak collector current.

Working from Lower Input Voltage

If it is desired to work the converter from a smaller input voltage, this can be done provided the original design does not work the transistors at the maximum rated peak current. A rough guide for finding the actual peak current in any one instance is to measure the battery current with an ammeter, and add on twenty per cent. The peak current in the transistors is made up of two components—the magnetizing current for the core, which is quite small, and the transformed current in the collector winding—transformed, that is, from the current in the output winding. The collector of each transistor has to supply both these currents, since both must flow in the collector circuit. Hence the rule outlined above, the extra 20 per cent. being the allowance for the core magnetizing current. Most transistor data gives the maximum allowable peak current in the collector, so that once the actual current is known, the data will tell us whether it is possible to increase it. In the present case, there is very little to spare when R has the value of 470 ohms, because the peak current is then about 240 ma., and the rated maximum for the OC72 is 250 ma. Thus, if it were proposed to run the converter from $1\frac{1}{2}$ volts instead of three, it would be necessary to choose transistors with a peak collector current rating of 500 ma. or more, since the actual current will be in inverse proportion to the voltage.

EXPERIMENTAL TV SIGNALS IN WELLINGTON



This photograph shows how the Electronics Institute's experimental transmitter situated at the Wellington Technical College was received recently at Upper Hutt. So far, only sample bar patterns like this one have been transmitted, but these are giving potential viewers a good idea of how well they will receive a picture from the experimental transmitter. Shortly, still transparencies, in the form of 35 mm. slides, will be transmitted from a flying-spot scanner system. The range at which this picture was received is approximately 20 miles, and the transmitter peak power was approximately 50 watts.

THE RCA DOUBLE-EMITTER DRIFT-FIELD TRANSISTOR TYPE 3746

Description and Applications

RCA-3746 is a general-purpose drift-field transistor of the germanium p-n-p alloy type, with two emitters. These two emitters permit the 3746 to be used in a wide variety of applications requiring control of an output current by signals from two sources. Such applications include: mixer-oscillator circuits in superheterodyne receivers, mixer-amplifier circuits, and switching circuits.

GENERAL DATA

Electrical:

At an Ambient Temperature of 25° C

Maximum DC Collector-to-Base Voltage (V_{CB}): With emitters No.1 and No.2 tied together, dc collector current of -50 μa, and dc base-to-emitter voltage of -0.5 volt	-34	volts
Maximum DC Collector Cutoff Current (I_{CBO}) For a dc collector-to-base voltage of -12 volts, and both emitters open	-16	μa
Maximum DC Emitter Cutoff Current (I_{EBO}) With emitters No.1 and No.2 tied together, dc emitter-to-base voltage of -0.5 volt, and collector open	-16	μa
Thermal Resistance (T_r):		
In free air	400	°C/watt
With infinite heat sink	100	°C/watt
Intrinsic Base Resistance ($r_{bb'}$)	55	ohms
Collector-to-Base Capacitance (C_{ob})	3.8	$\mu\mu$f

Maximum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-No.1-TO-BASE VOLTAGE	-0.5 max.	volt
DC EMITTER-No.2-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-20 max.	ma
DC EMITTER CURRENT (I_{E1} + I_{E2})	+20 max.	ma
TRANSISTOR DISSIPATION:		
At an ambient temperature of 25° C	80 max.	mw
At an ambient temperature of 55° C	50 max.	mw
At an ambient temperature of 71° C	35 max.	mw
AMBIENT TEMPERATURE:		
Operating	71 max.	°C
Storage	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
Current-Transfer Ratio (Measured at 1 kc):		
For I_{E1} = 1 ma, I_{E2} = 0	0.985	
For I_{E1} = 0, I_{E2} = 1 ma	0.985	
Alpha-Cutoff Frequency	40	Mc

Typical Operation:

In Mixer-Oscillator Circuit Shown in Fig.2

Signal Frequency = 1 Mc Ambient Temperature = 25° C

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-4.4	volts
DC Current in Emitter No.1 (Signal Emitter)	1	ma
DC Current in Emitter No.2 (Oscillator Emitter)	0.5	ma
Input Impedance (Signal Emitter)	25	ohms
Conversion Power Gain (1 Mc to 455 kc) for emitter No.1-to-collector load impedance of 300,000 ohms	26	db
Oscillator Voltage at Emitter No.2	80	mv

Typical Operation:

In Mixer-Oscillator Circuit Shown in Fig.3

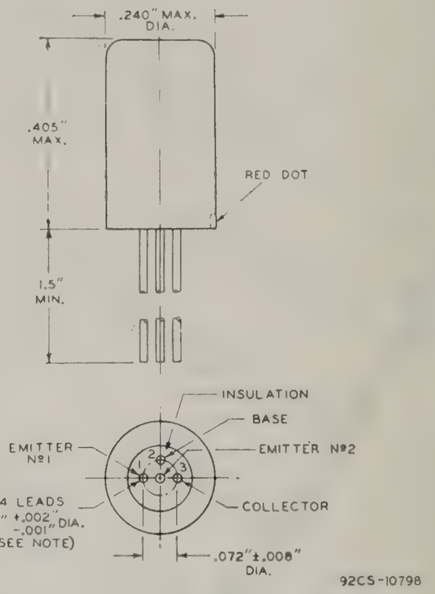
Signal Frequency = 1 Mc Ambient Temperature = 25° C

Common-Base Circuit, Emitter Input

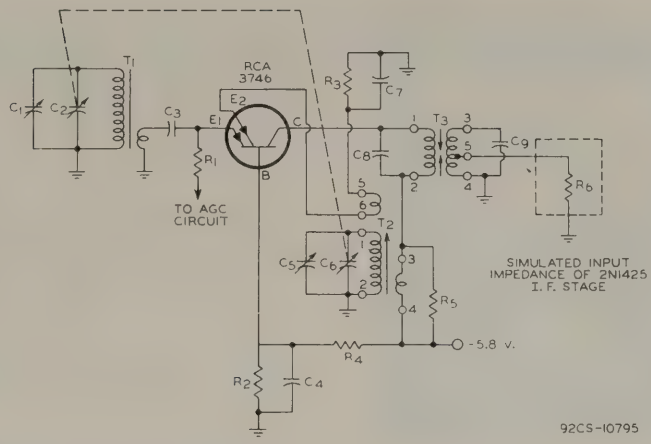
DC Collector-to-Base Voltage	-10.5	volts
DC Current in Emitter No.1 (Signal Emitter)	1.1	ma
DC Current in Emitter No.2 (Oscillator Emitter)	0.42	ma
Input Impedance (Signal Emitter)	23	ohms
Conversion Power Gain (1 Mc to 262.5 kc) for emitter No.1-to-collector load impedance of 346,000 ohms	27	db
Oscillator Voltage at Emitter No.2	145	mv

DIMENSIONAL OUTLINE
for RCA-3746

JEDEC No. TO-44



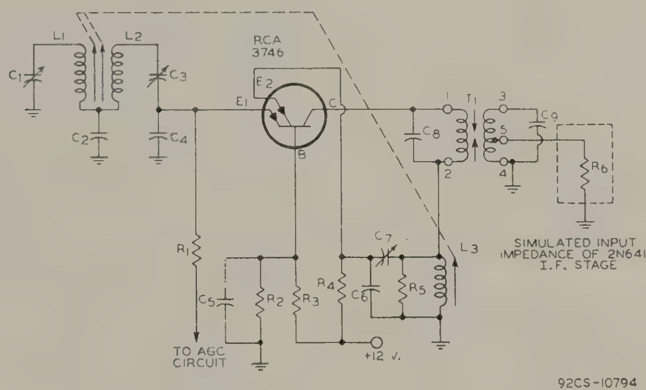
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE PLANE OF THE ACTUAL BOTTOM OF THE BASE. BETWEEN 0.250" AND 1.50" A MAXIMUM OF 0.021" DIAMETER IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.



C_1, C_5: Trimmer capacitors, 2-14 $\mu\mu f$
C_2: Antenna tuning capacitor, 7-158 $\mu\mu f$, ganged with C_6
C_3: 0.05 μf, paper, 6 v.
C_4: 0.47 μf, paper, 6 v.
C_6: Oscillator tuning capacitor, 7-78 $\mu\mu f$, ganged with C_2
C_7: 0.005 μf, paper, 6 v.
C_8: 36 $\mu\mu f$, silver mica, 500 v.
C_9: 40 $\mu\mu f$, silver mica, 500 v.

R_1: 1200 ohms, 0.5 watt
R_2: 4700 ohms, 0.5 watt
R_3: 2200 ohms, 0.5 watt
R_4: 12,000 ohms, 0.5 watt
R_5: 3300 ohms, 0.5 watt
R_6: 1800 ohms
T_1: Antenna transformer
T_2: Oscillator transformer
T_3: Intermediate-frequency transformer

Capacitor-Tuned Oscillator-Mixer Stage Utilizing RCA-3746.



C_1: Trimmer capacitor, 50 $\mu\mu f$ approx.
C_2: 0.01 μf, paper, 15 v.
C_3: Trimmer capacitor, 110 $\mu\mu f$ approx.
C_4: 0.005 μf, paper, 15 v.
C_5: 0.2 μf, paper, 15 v.
C_6: 0.0033 μf, paper, 15 v.
C_7: Padder capacitor, 550 $\mu\mu f$ approx.
C_8: 47 $\mu\mu f$, silver mica, 500 v
C_9: 50 $\mu\mu f$, silver mica, 500 v.

L_1, L_2: Antenna-transformer windings
L_3: Oscillator coil
R_1: 1500 ohms, 0.5 watt
R_2: 22000 ohms, 0.5 watt
R_3: 5600 ohms, 0.5 watt
R_4: 4700 ohms, 0.5 watt
R_5: 3300 ohms, 0.5 watt
R_6: 1400 ohms
T_1: Intermediate-frequency transformer

Inductance-Tuned Oscillator-Mixer Stage Utilizing RCA-3746.

A.G.C. Characteristic

Automatic gain control for the 3746 in mixer-oscillator applications may be obtained by variations of the curren in the signal emitter (emitter No. 1).

Operating Considerations

The flexible leads of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided that care is taken to conduct excessive heat away from the lead seal.

It is recommended that this transistor not be plugged into or disconnected from circuits with the power on, because otherwise, high transient currents may cause permanent damage to the transistor.

RADIO HAS REVOLUTIONIZED WAR AGAINST CRIME

By CHARLES A. F. AUSTEN, *London writer on industrial, trade, and technical topics.*

It seems a far cry from the sordid London murder, in 1910, of an unsuccessful music hall artiste called Belle Elmore, to the transistorized marvels of the modern electronic era. Therefore, one might well have wondered why Scotland Yard should have chosen Britain's recent National Radio and Television Exhibition at which to place on public view its biggest selection, so far, of grisly crime relics from its world-famous Black Museum.

Yet the reasons were not far to seek. The United Kingdom Government had just been host to the United Nations Congress on Crime Prevention. And a number of delegates to the Congress were certain to visit the Scotland Yard exhibit at the Radio Show as it marked the completion of the first half-cenutry of the use of radio and electronics as an aid to crime detection and prevention.

First "Radio" Arrest

Dominating the exhibit was an enlarged reproduction of a telegram, code-addressed to "Handcuffs, London", announcing the arrest of Belle Elmore's murderer—her husband, Dr Hawley Harvey Crippen. After his crime, Crippen fled the country with his typist, Ethel Le Neve. The couple's presence was recognized in the steamship *Montrose,* outward bound from Antwerp for Quebec, by the vessel's master, Captain Kendall.

Radio was then in its infancy, but Captain Kendall's radio telegram from mid-Atlantic to the Liverpool police enabled Detective-Inspector Drew, of Scotland Yard, to board a faster ship, overtake the *Montrose* and take Dr Crippen into custody. Thus began a new era in crime detection.

Since then almost every advance by Britain's scientists, technicians, and manufacturers in the field of radio communication, has added weapons to the police armoury. Today the police forces of the United Kingdom are among the major users of radio and electronic equipment and most of the British manufacturers concerned are specially designing and exporting such equipment for police use in other countries.

Rapid Progress

The police chapter in the 50-years' story of Britain's radio progress is long and interesting. Within twelve years of Crippen's arrest, the British Broadcasting Company (forerunner of the present British Broadcasting Corporation) had been formed. In the same year—1922—radio police patrol cars were on the streets of London. Next came radio-equipped police river craft, and in the 1930s a radio-equipped Information Room at Scotland Yard began to cope with the "999" emergency telephone call system. In 1959 this system alone resulted in 15,144 arrests.

Some 14 years ago, Britain began "beaming" fingerprints and photographs of suspects to other countries. This soon became a regular procedure, and although the speed of jet aircraft has since reduced its necessity, it is still used in urgent cases. Only a few months ago, the fingerprints and face of a known criminal were beamed from Suva, in the Fiji Islands, and identification was established.

Scotland Yard has always employed its own electronics engineers, to whose specifications various new crime-checking devices have been brought into being. When the Information Room was founded in 1934, transmissions were made to patrol cars in the Morse Code, and this continued until 1946 when, after considerable experimentation, frequency-modulated R/T was introduced. During 1956, time-absorbing effort in the Information Room was further cut to the barest minimum by modern electronic and other devices which ensured even more the rapid processing of information to the man on the beat.

Scotland Yard is, of course, Britain's national centre office of Interpol (International Criminal Police Organization), with whose headquarters in Paris, together with some 19 other European and Mediterranean countries, it maintains a radio link. Visitors to the Radio Show saw a police operator transmitting and receiving Interpol messages and a Telex teleprinter with autosender passing the Interpol messages to and from Scotland Yard.

Motor-cycle Communication Link

In common with Scotland Yard, provincial police forces also have their Information Rooms where Creed teleprinters are installed. It is interesting to note, by the way, that the makers of these teleprinters—Creed and Company Ltd., of Croydon, Surrey, England—have announced the introduction of a new high-speed printer designed to operate at 1,000 words a minute. This was shown in prototype form at the recent Business Efficiency Exhibition held at Olympia, London and will be in full production in 1961. This too, may well have its police uses.

Among the communications equipment used by Scotland Yard is that on the new lightweight patrol motor-cycles. The equipment is normally silent and only comes alive on a signal from headquarters. At

night, if the officer on his beat has to leave his motor-cycle unattended, the radio telephone installation is set to remain alive, but is mute until attended to. A lighting device informs the returning officer that he has been called during his absence from his machine.

In the London Metropolitan Police area alone, about 140 of these motor-cycles are now being used for boat patrol or traffic control duties. Other mobile forces in the area bring the total of radio-equipped road vehicles to 400, and all are in regular radio telephonic communication with Scotland Yard.

Electronics are increasingly used by Britain's police for duties other than the detection and preventing of crime. Short-range "walkie-talkie" sets have been used for some time, usually where crowd concentrations have made extra police attendance necessary. In these cases, a radio control van is usually employed with the "walkie-talkie" sets.

The "nerve centre" of Britain's fight against crime—the Information Room at New Scotland Yard, London. Here the latest radio and electronic systems provide a link not only with police forces in Britain, but with many parts of the world.

Television Aids Traffic Control

Scotland Yard first made tests on the aerial observation of traffic conditions in the 1920s, using balloons and an airship, and also in the 1930s, using aircraft. Today, Auster aircraft, in direct radio telephonic communication with control points on the ground, help to unravel traffic jams occasioned by big sporting events and outdoor ceremonies of a national character.

In the natural sequence of events, we have the arrival of the television policeman, to round off this remarkable half-century story of police telecommunications. When the King and Queen of Thailand visited London, Scotland Yard used, for the first time on such an occasion, a closed-circuit television unit for observing crowd concentrations.

The system employed two cameras mounted on a 20-feet high tower on the south side of London's Trafalgar Square. One surveyed traffic and crowd conditions in Northumberland Avenue, Whitehall, and The Mall, while the other covered crowd movements in the Square itself.

Both cameras were remotely controlled from a police vehicle containing two television receivers. The police officers concerned were able to make one or both cameras pan round or remain stationary at will. The installation was an experimental one to enable the police to gauge the effectiveness of television control techniques. The potentialities are obvious.

Meanwhile, closed-circuit television for ordinary traffic control is being developed. A typical system is that which enables one policeman to control four busy traffic lanes. It is being used successfully, in all weather conditions, at West Drayton, Middlesex, England, while road-widening work is in progress. Without television, it would have required three policemen on each tour of duty to regulate the traffic every day over the last six months. In this case, the camera is mounted on a lamp standard, 20 feet above the ground and, to protect it from rain and frost, it is enclosed in a special weather-proof housing. Even under difficult lighting conditions, it is able to relay good-quality pictures to the police box.

Constant research by United Kingdom manufacturers will, it is safe to predict, yield many more new products and processes which will be adaptable to anti-crime uses, both at home and overseas, as the second half-century of police radio communications opens.

Manufacturers engaged in the design of police and electronic equipment used by British police forces are:

Fixed Equipment at Police Stations: The General Electric Company Ltd., Magnet House, Kingsway, London, W.C.1; Cossor Communications Company Ltd., Honeypot Lane, Stanmore, Middlesex; Pye Telecommunications Ltd., Newmarket Road, Cambridge.

Mobile Equipment: Marconi's Wireless Telegraph Company Ltd., Chelmsford, Essex; Ekco Electronics Ltd., Southend-on-Sea, Essex, England; Cossor Communications Company Ltd.

Auster Aircraft Equipment: Pye Telecommunications Ltd.

Walkie-Talkies: Cossor Communications Company Ltd.

Closed-Circuit Television Equipment: Electrical Musical Industries Electronics Ltd., Hayes, Middlesex, England.

ELECTRICAL AND TRADE SECTION

TRADE WINDS

NEW ROLA SPEAKER FACTORY OPENED

Above are two illustrations of the new factory recently opened at Rishworth Street, Wingate, Lower Hutt. The opening ceremony was performed by Mr P. Dowse, Mayor of Lower Hutt, and the Rola Company entertained a large gathering of friends and clients to afternoon tea afterwards. There are already two speaker assembly lines in operation, while there is ample space available for the addition of others later. Rola intend, when the time is ripe, to go into the production of components for television, and the production of magnetic recording tape. The latter is already being poduced from imported wide tape by splitting into the standard quarter-inch width, and spooling, but we believe that later on, it is intended to coat tape at the Lower Hutt factory.

* * * *

ANOTHER BIG RADAR ORDER FOR NEW ZEALAND

Following on the supply and installation of the world's first high-power 50 cm radar at Wellington, New Zealand, and a contract in hand for a similar installation at Ohakea Airfield, Marconi's have now been awarded a third big radar contract by the Civil Aviation Administration (Air Department) of New Zealand. This calls for the supply and installation of two 50 kW, 50 cm surveillance radars Type S264, together with three display consoles Type SD701 and other ancillary equipment, at Momona Airport, Dunedin.

The Type S264 radar has met with very considerable success as an installation principally concerned with the regulation of aircraft approaches and departures from an airport terminal area. It is capable of handling aircraft approaches from distances well in excess of 100 miles (161 km) and feeding information to an I.L.S. (Instrument Landing System) or P.A.R. (Precision Approach Radar). Similarly, it can regulate departure separations out to these distances.

Operating as it does on a 50 cm wavelength, aircraft echoes are not obscured by any form of precipitation. The centres of heavy rainstorms are, however, faintly visible on the display screens, a positive advantage in

that the aircraft can be plotted through these storm centres or, alternatively, guided round them.

The S264 is completely crystal-controlled, a feature which permits the use of a particularly efficient M.T.I. (Moving Target Indicator) for the suppression at will of permanent echoes, thereby materially contributing to the equipment's excellent short-range performance. Outgoing aircraft can be plotted from take-off and incoming aircraft to touch-down.

* * * *

REVISED LIGHTING HANDBOOK OFFERED BY WESTINGHOUSE

A new edition of the Westinghouse *Lighting Handbook* has been announced by the Westinghouse lamp division.

The revised edition contains comprehensive coverage of the general field of modern lighting practices, according to Marshall N. Waterman, commercial engineering manager of the Westinghouse large lamp department. Included in the 250-page pocket-size manual is a fold-out page in full colour of the electromagnetic spectrum, information on distribution and light measurements, a section on the newest light sources, information on coefficients of utilization and maintenance factors, together with footcandle tables, and many application illustrations useful in dealing with modern lighting problems.

In the new booklet, major revisions have been made to the chapters on floodlighting design, roadway lighting and sign lighting. Also, the most recent recommendations of the Illuminating Engineering Society for commercial and industrial interiors are included.

In addition, the manual contains chapters on interior wiring, school and office lighting, store lighting, industrial and architectural lighting, germicidal and sun lamps, and the cost of lighting. According to Mr Waterman, the compact handbook is indispensable to every lighting engineer, designer, electrical contractor, and architect who deals with lighting installations.

The Westinghouse *Lighting Handbook* was first published in 1941 as an outgrowth of the original Westinghouse Correspondence Course in Illumination, published in 1928. Available at cost, it is made up in a pocket-sized edition, 5¼ in. by 7½ in. with a wire-o binding which permits the pages to lie flat when the book is open. The binder is made of soft leatherette with silver stamping.

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RADIO AND TELEVISION TRENDS IN BRITAIN, 1960

Our British contemporary *Wireless and Electrical Trader* has the following comments to make after viewing the 1960 Earl's Court Radio and Television Show. To New Zealand readers, it will be interesting to find that in this country we are as well up with the latest developments in domestic equipment as can reasonably be expected. Of course items like AM/FM transistor receivers have no application here, while it is only to be expected that the latest "gimmicks" in TV receivers over there will be rather ahead of our ones.

Television

The bigs news in television receivers at this year's Show is in larger screens, better cabinet styling and sound quality, automatic devices, lower prices, and improved servicing facilities. Larger screens form the theme of the Show, and this is supported by the introduction of the 23 in. cathode-ray tube which, although no wider than the 21 in., has a larger area.

Cabinets, including table models, are more attractive as pieces of furniture. Curved contours give cabinets a pleasing appearance, and there is a greater use of doors to cover the screen when not in use. In many cases the screen is flanked with twin speaker apertures, while optional legs turn them into low-priced consoles, yet prices are several guineas down.

New devices include press-button station selection without the need for fine tuning, automatic contrast control, and reduction of line whistle. There are TV/FM and TV/AM models.

Audio

Stereo has made its mark in the audio field, and there is hardly a radiogram of the conventional console type that does not make provision for it. Many of them have both speakers integrated with the cabinet. Several exhibitors offer transistorized radiograms, in some cases with a pre-tuned radio signal.

The large influx of stereo and mono record reproducers last year is maintained, and it is now matched by a similar rise in the number of tape recorders, priced from 22 gns to more than £100. Several of these use the 4-track system, and many of them can be operated stereophonically. High-fidelity equipment is represented more by luxury-type complete equipments than by combinations of separate units. Demonstrations of audio equipment are given in soundproof rooms in the Audio Hall.

Radio

Transistors make their impact felt this year, and their influence is the principal reason for the public's revival of interest in radio. Their advantages are reflected not only in their lightness and smallness, but also in their economical operation from batteries.

They are even challenging the table mains set. Several transistor table models are now available and are known as "cordless" receivers.

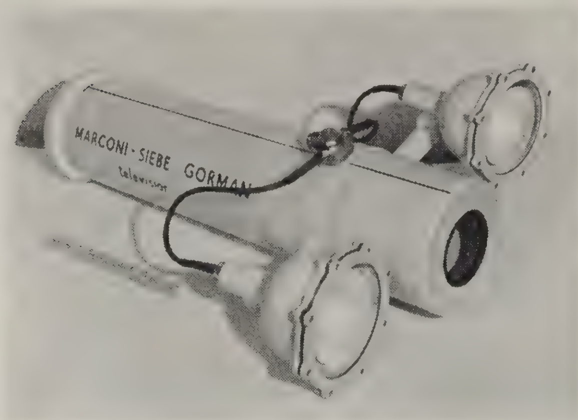
Most of them operate on A.M. only, but there are several A.M./F.M. table models. The large majority of transistor sets are portable, of course, and suddenly this year numerous models are offered in very handy and attractive pocket-size cases.

Valve portables are completely eclipsed, and the larger transistor portable often include F.M. reception. Most portables have car aerial sockets, and some are provided with quick-release fixing brackets to facilitate their use in cars. Closely allied to the radio portables are transistor record reproducers and even radiograms.

LATEST OVERSEAS DEVELOPMENTS

NEW UNDER-WATER TELEVISION CAMERA

First-time Showing



At the second Industrial Photographic and Television Exhibition, Marconi's Wireless Telegraph Co. Ltd. are showing and demonstrating a selection from their extensive range of closed circuit television equipments.

One of the new equipments, on view for the first time, is the Marconi-Siebe, Gorman underwater television camera type BD928. This is primarily a handheld equipment with overall dimensions (including casing and lamps) of only 3 ft. x 2 ft. 3 in. It can be buoyancy-adjusted for virtual weightlessness under water, thus providing the maximum handiness for a diver carrying out investigations.

* * *

NEW VARIABLE MAGNETOSTRICTION DELAY LINE

Magnetostriction delay lines in which mechanical pulses are transmitted along wires have been used for some years for storage and time delay purposes in computers, simulators, and other electronic systems. Only recently have the techniques for giving continuous variation of time delay been sufficiently developed to make possible a reliable manufactured article.

Ferranti Electric, Inc., of New York, U.S.A. have just introduced a variable magnetostriction delay line which is available with delays variable throughout the range of 2 microseconds to 10 milliseconds. The digit rate of the line is up to 500 Kc/s and the fluctuation in delay time is less than 1 millimicrosecond. Settings of delay time are linear and reproducible to an accuracy of 0.1%.

Continuous variation of the delay time is obtained by a mechanical control, through a low-torque, recirculating ball-race drive, suitable for manual or servo operation. Micro-switches provide an electrical indication of when the limits of variation are reached, and mechancal end stops prevent over-driving.

CLOSED CIRCUIT TV CAMERA WITH NEW IMPROVED LENS TURRET

First-time Showing

Picture shows a Marconi closed-circuit television camera fitted with a new and improved two-lens turret which can accommodate any pair of standard lenses of focal lengths between 10 mm and 150 mm. The lens change mechanism is motor driven and remotely operated. Special attention has been given to accurate registration and rapid, smooth, lens change-over.

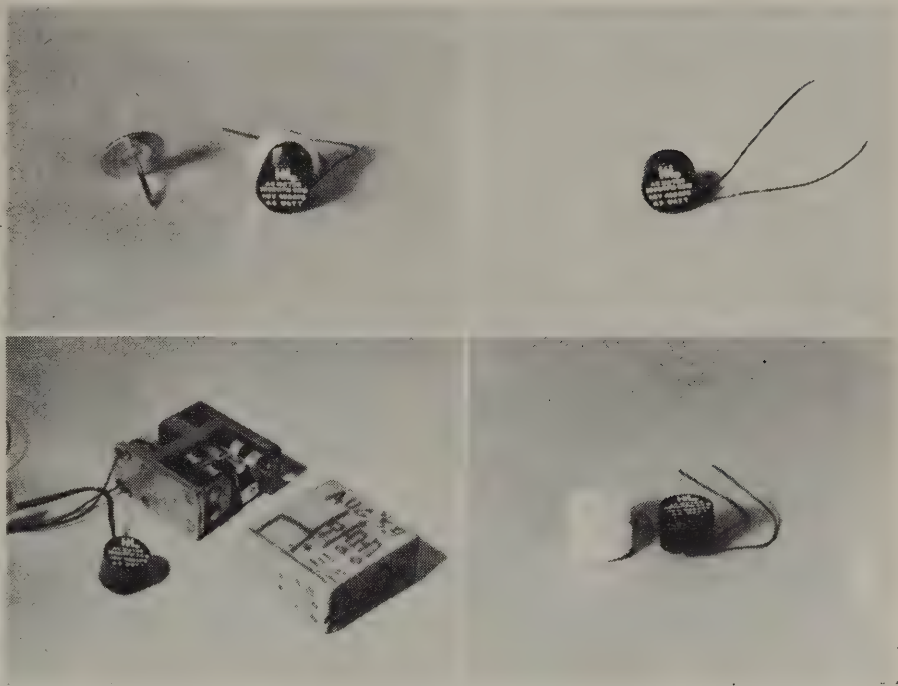
An optional extra permits the incorporation of neutral density filters or shutters control for (among other things) automatic protection of the camera pick-up tube from the effects of sudden high-intensity light.

SMALLEST TIMING DEVICES IN THE WORLD ANNOUNCED

Pair of Micro-Miniature Timers Driven by Asprin-sized Motor

WATERBURY, Connecticut, September 21, 1960.—A lilliputian motor, worth approximately twenty times its weight in gold, is the power source for equally small elapsed time indicators and repeat cycle timers, the A. W. Haydon Company, Waterbury, Conn., manufacturers of the micro-miniaure trio announced.

Small enough to be hidden behind an ordinary thumbtack, the 115-volt, 400 cps. single-phase, hysteresis-type motor measures $\frac{3}{8}$ in. in diameter by 9/32 inch in length, and consumes less than one-half watt of power. The torque of the motor is rated at 1.5×10^{-6} horsepower (0.0005 ounce-inches), and its weight is given at 1/9 ounce.



(Top left): The smallest motor in the world weighs only 1/9 ounce. (Top right): The A. W. Haydon Comany motor, the smallest in the world, can easily be hidden behind an ordinary thumbtack. (Lower left): Be careful that the aspirin you swallow is not the A. W. Haydon motor instead! (Lower right): Shown beside a $\frac{1}{2}$ in. x 1 in. x 1 in. eraser is the new 19400 Series Micro-miniature A. W. Haydon Company repeat cycle timer. One afternoon in August, 1959, A. W. Haydon came up with the idea for a truly micro-miniature timer. He wanted to manufacture a reliable timer smaller than anything on the market because he realized that industry and the military needed such an advanced item. An eraser was handy, so Haydon hewed it down to $\frac{1}{2}$ in. thick by 1 in. square. On it he sketched a motor and switches as he envisioned the timer might be designed. From his idea and this unusual mockup, company engineers went to work. Two months later, concentrated design and engineering effort resulted in the manufacture of first prototype models. As the drive motor, also shown in this photo, had to be designed as well, it is quite a significant achievement.

Company engineers stated that the motor would be especially useful for instruments and computers actuating selector switches, tape handling, and process timing. Its small size makes it particularly adaptable as an OEM component where space is limited, they said.

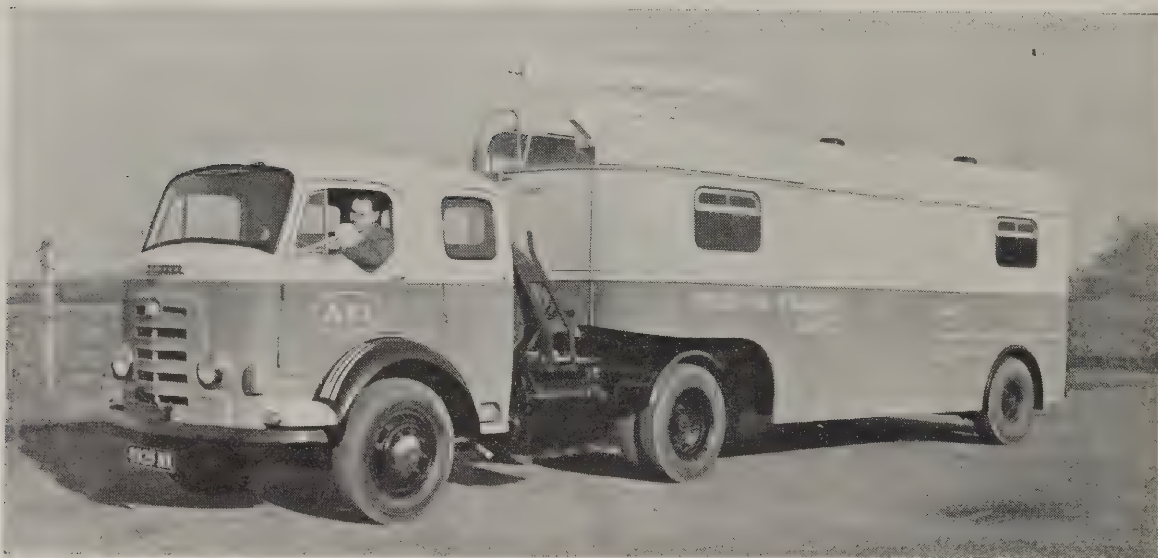
The motor was specifically developed, however, to power a hermetically sealed repeat cycle timer measuring $\frac{1}{2}$ in. x 1 in. x 1 in. Three roller switches in the timer are driven at 1 r.p.m. by the motor, while the switches in the device are rated for seven amperes resistive at 28 volts D.C. and 5 amperes resistive and inductive at 115/230 volts A.C. 60 cycles.

Designed for repeated switch control functions where space and weight considerations are primary, the one-ounce timer can be used in airborne computers to pulse or programme circuits, or in any conventional timer application, as for example telemetering, programming of circuits, or any application utilizing a time base. It is said to have outstanding resistance to severe environmental conditions.

The second device powered by the "fleapower" motor is the smallest practical digital elapsed time indicator ever manufactured. The four-digit indicator measures only one-half inch square by 1 1/16 inch long, and operates from a frequency of 400 cps. Weighing three-quarters of an ounce, the instrument comes in two models; one reading tenths of hours, and the other registering hours. Both employ four-digit, drum-type counters having a range of 999.9 and 9999 hours respectively. The white numerals on a lusterless black background offer excellent readibility—even at a glance—despite the tiny size, simplifying reading problems and eliminating errors associated with dial face indicators.

While designed for use in all situations requiring a measurement of running time, company engineers believe that its main use will be as an integral part of expensive electrical or electronic machinery to indicate actual running time. The manufacturer stated that many costly "black boxes" are returned by customers to the fabricators with the claim that running-time guarantees have not been met. A simple check of this highly accurate micro-miniature timer will obviate this trouble, the engineers stated.

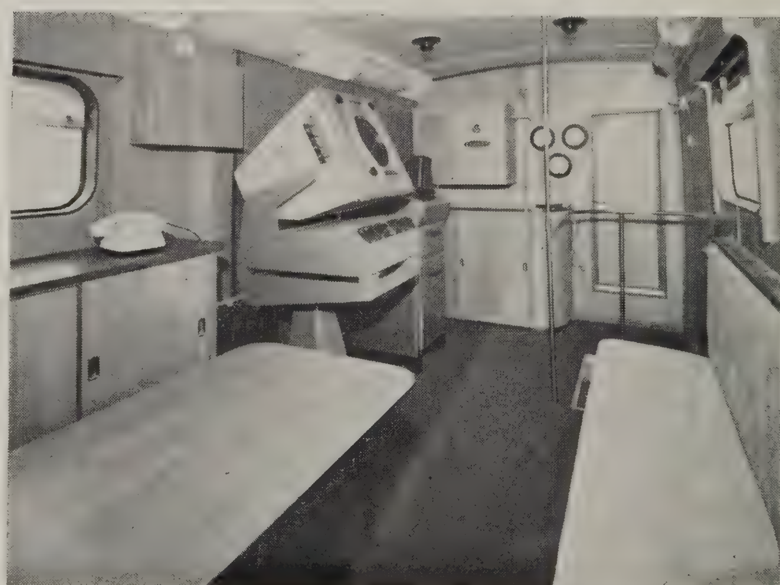
MOBILE RADAR UNIT TOUR OF EUROPEAN COUNTRIES



Associated Electrical Industries Ltd. has equipped a mobile radar unit with marine and associated apparatus, and has just completed a five-month tour of European countries to give "on the spot" demonstrations.

The unit, in the charge of two A.E.I. engineers, visited thirty different centres and travelled altogether 5,000 miles giving demonstrations at ports in Belgium, Holland, Germany, Denmark, Sweden, Norway, France, and Italy.

Two marine radar sets were shown and were operated from the vehicle's own power supplies; one was the "Escort" (as fitted in the liner *Queen Elizabeth*) and the other was type RMS-2. Also included were other marine products supplied by various divisions of A.E.I.: these included teelphones, signalling and bridge instruments and fluorescent lighing equipment. Power for the unit was obtained from a 6-kW, engine-driven generator, the generator also being a product of A.E.I.



External and internal views of the A.E.I. mobile radar statios, showing the rotating aerial and the display unit.

During the tour, visitors to this mobile radar unit had the opportunity of seeing the advanced design of the products on view. The main feature was the "Escort" radar—embodying facilities which enabled the display to interpret a situation instead of merely recording it. This feature is termed a "Chart-Plan" display. Visitors could also see the care taken to

(*Continued on page* 37)

TV IN BRITAIN—FLASHES FROM THE EARLS COURT EXHIBITION

Pye Show the First British Transistorized TV Set

To be available to the public almost immediately is the Pye transistorized portable TV set. And the price will be in the vicinity of £100!

The set has a 14 in. tube, and uses 26 transistors, 11 germanium diodes, 3 silicon diodes, and a thermionic power rectifier. It is able to receive all B.B.C. and I.T.A. channels, has a built-in aerial, and weighs 38 pounds. It is designed for normal mains operation, but has a four-position switch giving (a) working from a built-in. non-acid accumulator, (b) mains operation plus trickle-charging of the battery, (c) full-rate battery re-charging, and (d) operation from a 12-volt car battery with positive earthed.

* * *

Ferguson, the Second!

Hard on the heels of the above announcement came one by Ferguson of a transistor portable TV set using a 7 in. picture tube. This set weighs only 20 lb., uses 24 transistors and 15 semi-conductor diodes, and two E.H.T. rectifiers. The battery gives up to four hours' viewing, and the set incorporates a charger operated from the mains. When a mains outlet is available, the set can be operated directly from the mains. Production is expected to start early in 1961, and the price including battery is expected to be under £100.

* * *

British TV Sets Now Featuring Remote Control

A feature of several sets shown at this year's Earl's Court Exhibition is remote control. Some sets have a small arm-chair control unit linked to the set by a long cable, but others are using "wireless" control systems. For example, the H.M.V. unit achieves control by transmitting ultrasonic pulses in the vicinity of 40kc/sec. Three channels are used, spaced about 3kc/sec. apart. One operates the tuner turret to give channel selection, while the others provide for increase and decrease of volume. With a receiver incorporating effective vision A.G.C., there should be no need to have remote control of brightness or contrast.

The "transmitter" is transistorized, and feeds a small loud-speaker type of transducer, which will work within about 20 feet of the receiver.

* * *

Automatic Contrast Adjustment

Another gadget that is just now coming to the fore in production TV sets is automatic contrast control. This is arranged to compensate for changes in the ambient lighting conditions. A photo-conductive cell is arranged to act as a light-variable resistor in the contrast control circuit, and is made to "measure" the ambient light falling on the picture tube face by being placed in a small window in the front of the cabinet. Several manufacturers, including Philips, McMichael, Kolster-Brandes and Sobell, are featuring this system in their latest sets.

* * *

RESEARCH TEAM FINDS 1000-MILE POWER LINES FEASIBLE

PORTLAND, U.S.A.—Problems associated with the transmission of electrical energy over long distances up to 1000 miles can be solved, according to an electric industry research team which reported recently the progress of its studies.

The announcement was made in the United States by E. Robert de Luccia, vice-president and chief engineer of Pacific Power & Light Company, in Portland, Oregon, and Joseph K. Dillard, manager of the electric utility engineering department of Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania.

"Voltages up to 690,000 volts with lines capable of carrying more than 3,000,000 kilowatts of electric power were studied," Mr de Luccia reported. The voltage is nearly double the highest now operating in the U.S.

"With the aid of digital and analog computers the team was able to determine the effectiveness of corrective devices which were used to stabilize the ultra-high voltages over the full length of the circuits," the power company official said. He added that the study was undertaken in connection with the United States electric industry's long-range planning for the future.

The transmission distances and the higher voltages being considered in the research are greater than those now operating anywhere in the world, according to Mr de Luccia.

He said the primary purpose of the two-year study was to find the answers to problems arising from electrical phenomena associated with circuits exceeding 500 miles in length.

Mr Dillard said: "Now that it has been determined that such lines can be operated, the utility industry can compare the economics of extra-long distance transmission with the alternate of transporting fuel to power plants at the load centres of the nation. The industry will be able also to determine the best possible sites for the larger-capacity generating plants that will be required in the future.

"The knowledge would be helpful also in the future for evaluating innovations that are yet to be developed for energy transmission," Mr Dillard added.

RADAR RECORDING AND TRAINING EQUIPMENT APPLICATION IN CIVIL AVIATION

The radar recorder and playback equipment is now being accepted as the logical approach to many of the traffic problems which exist today. In conjunction with a simulator and/or raw radar it has the following applications.

(1) *Traffic Analysis*

The radar trainer is being used to record various aspects of the traffic flow around major airports. This record is played back and analysed to ensure that maximum use is being made of the time and facilities available. Simulated targets are then introduced to establish if, with alterations in the traffic flow any advantages can be obtained in time and safety.

(2) *Traffic Record*

A permanent record of all air activity up to 240 miles, or to the total range of the local radar can be maintained and used for reference if required. A tape recorder housed in the equipment could also be used to record R.T. if so desired.

(3) *Simulation*

Most traffic flow problems are simulated to assess the merits of one system versus another but to consider all aircrafts over a large area needs simulation of a vast quantity of targets.

It is now possible with the radar trainer and a simulator (with a limited number of controlled targets) to produce a radar picture with unlimited simulated targets superimposed on a raw radar picture with local permanent echoes.

The picture is obtained by recording, say, 12 simulated targets on predetermined courses then turning back the recorder and repeating the process until the required number of targets are available.

In a similar manner raw radar and local permanent echoes are recorded and during playback the 12 local controlled simulated targets can be superimposed on the picture.

With all this information available, a complete survey analysis and training can be achieved in one centralized H.Q.

(4) *Jet and Propeller Problems*

Where jet and propeller aircraft are both using an airport the problem of bringing the jets through the flow path of propeller aircraft can be simulated.

Control, timing, and safety can be assessed from this system.

(5) *Stacking*

Simulation and recording of aircraft in stack formation with a background of local permanent echoes can be achieved and checks taken on the emergency procedure to take any aircraft from the stack for landing.

(6) *Survey*

With the radar trainer in a mobile vehicle it is possible, in conjunction with local radars to record all permanent echoes, local traffic and remote stations and take this information back to H.Q. for analysis and integration into an overall planned system.

(7) *Training*

With the use of the radar trainer and simulator training can be centralized with the advantage that the controllers have available a background picture of the airport they will be operating, thus H.Q. training with records of all local permanent echoes of other airfields is now possible.

(8) *Future*

(a) With the increase of privately owned aircraft and helicopters crossing the main air lanes, simulation and playback can assist in future planning and keep the control and safety factors well in hand.

(b) Recording and playback of information derived from height-finding equipment could possibly allow training of controllers for blind landings without the intial use of actual aircraft.

* * *

NEW ONE-INCH VIDICONS FOR INDUSTRIAL LIVE-SCENE PICK-UP

R.C.A. are pleased to announce two new 1-inch vidicons—R.C.A. 7735 and R.C.A.-7262-A. Both of these new tubes utilize a recently developed photosensitive surface of extremely high sensitivity and uniformity which promises improved performance in industrial and other closed-circuit TV applications. The 7735 and the 7262-A are capable of producing pictures of satisfactory quality with as little as 0.1 footcandle illumination on the faceplate.

Still another feature of these new tubes is the increased voltage ratings which permit substanital increases in both the amplitude response and the limiting resolution capability—from 600 TV lines to approximaetly 900 TV lines.

The 7735 employs a 6.3-volt/0.6-ampere heater, has an overall length of approximately 6¼ inches, and is designed for conventional TV camera equipment. Its shorter companion tube, the 7262-A, employs a 6.3-volt/0.095-ampere heater, has an overall length of approximately 5⅛ inches, and is designed especially for compact, transistorized TV cameras.

R.C.A.-7735 and R.C.A.-7262-A are the commercial designations for the Developmental Types C-74019 and C-74035, respectively.

Further information will gladly be supplied upon request.

TELEMETRY

(*Continued from page* 18)

recovered from them.

One way of sampling a number of circuits one after the other is to use a simple mechanical commutator, or rotating switch, which feeds information successively from all the transducers to the sub-carrier modulator circuit. Exactly the same thing can be done electronically by generating trains of pulses, and mixing them together after they have each been modulated by their respective transducers. Considerable use is made of motor-driven commutator samplers at the transmitting end of the telemetry system, because these save a great deal of electronic circuitry. At the receiving end, however, electronic switching is usually used, because the space and weight limitations are no longer so pressing and because their reliability over long periods is superior.

(To be continued)

BOOK REVIEWS

(*Continued fom page* 19)

amateur constructor, and embodying the "meat" of articles previously published in *Radio-Electronics*. Descriptions are given of circuits of a wide range of small and inexpensive devices using transistors, and suitable for the amateur constructor. There are, for example, nine articles on transistor radio receivers of various kinds, nine on transistorized simple instruments, and thirteen on miscellaneous transistor devices. Among the latter is an interesting gadget described as a broadcast band booster. This turns out to be nothing other than an outrigger R.F. amplifier stage, tunable over the broadcast band, and coupling its output, without the need for physical contacts of any sort, via the ferrite loop aerial of the receiver itself! For those who are attracted by transistors and want to "play", this little book would be a worth-while investment, in spite of the fact that many of the transistor types mentioned are not directly available here. There should be little difficulty in finding available transistor types which will work well in all these circuits.

MOBILE RADAR UNIT

(*Continued from page* 34)

simplify the operating controls and to reduce the complexity of the equipment to an essential minimum.

The other radar equipment on show was the type RMS-2—the performance and reliability of which has already been proved at sea.

A.E.I. fluorescent lighting for ships was demonstrated by six fittings set into the angle between the walls and the ceiling of the demonstration room. These were of a popular enclosed type. using Mazda 2 ft. 20-watt lamps supplied at 220 volts D.C. Two similar fittings were used for lighting the front of the trailer unit.

The A.E.I. telephones shown were of the latest type for marine purposes. Those in the demonstration room were centenary neophone instruments—the first printed circuit telephones developed. They are as used in passenger cabins on large luxury liners and are available in a wide range of colours.

Communication between the tractor and trailer units was by means of navigational telephones, the one in the tractor unit being of the transistorized noise cancelling type which includes an amplifier for use with an external loud speaker. The telephone in the trailer unit provided communication with the main demonstration room, and was of the standard marine type. Such telephones are in widespread use for engine room/bridge communication on merchant ships.

As already mentioned the vehicle had its own power supply and it is of interest that the voltage was stabilized by an A.E.I. magnestat voltage regulator. This equipment provides very close stabilization for large fluctuations in load, and is of a type used extensively for marine installations.

S.B.A.C. FARNBOROUGH FLYING EXHIBITION

Radio Remotely Directed T.V. System for Airfield Application

Pye Telecommunications Limited are showing a new radio directed television system for airfield application, which is completely transportable and independent of cables.

The system permits control tower staff observation of areas they cannot see and all assembly areas, taxiways, and runways, especially during operational periods of low visibility. It can also give close observation of aircraft takeoff and landing performance at test and experimental airfields.

The use of a radio remote control link makes for a system of greatly increased flexibility, the distance between the control point and the camera being almost unlimited for most practical purposes.

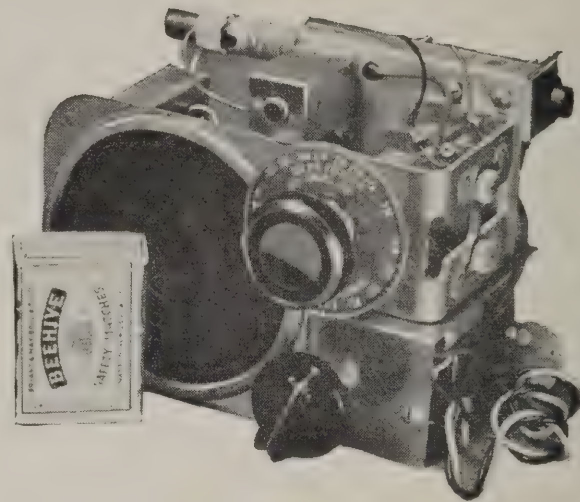
PRINTS OF PHOTOGRAPHS

Prints of technical photographs appearing in this Magazine have in the past been available to readers, but it has now become necessary to make a revision of prices. The following are the current prices for prints, including postage.

8 x 10	8/-
8 x 6	6/-
6 x 4	4/6

A NEW PORTABLE KIT-SET

Outstanding Performance from this 7-transistor basic kit, type B/14



* Latest type Transistors.
* Unit construction consisting of Audio section (ideal also for small gramophone portable), I.F. section, and Aerial-Oscillator section.
* Tuning section incorporates tracking condenser and vernier glass dial.
* Metal work of non-corrosive material.
* Total battery consumption 7½m.a. (9V.).
* Medium size components used. Easy to repair and replace. No special skill or equipment needed in wiring. 3 in. speaker illustrated. A 4 in. speaker may be mounted at the side, if preferred. Overall size (as illustrated), 5¾ in. x 4 in. x 3¼ in. in depth.

B14 BASIC KIT consists of :Type 97, Audio Chassis; Part No. P70, I.F. Chassis; Part No. P71, Aerial/Oscillator Chassis; Type DF/2, Tuning condenser with vernier drive; Type SC/18, Glass Scale; Type 191, Oscillator Coil (126u.H.); Type 32, 1st and 2nd Transformers; Type 72, Diode I.F. Transformer; Type 210/1, Rod aerial winding.

Note: (1) Ferrite rod ⅜ in. dia. x 8 in. not included with kit unless specified. (2) For those winding their own loops or rod aerial, inductance when in position should be 235 uH. for correct tracking and dial calibration.

PRICE: £5 2s. 0d.

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Model 330 B — DISTORTION ANALYSER

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Measures noise as small as 100μv
High sensitivity, high stability
Measures distortion as low as 0.1%
Wide-band 20 db gain amplifier
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Use It to Determine:

Total audio distortion
Voltage level, power output, gain
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Noise and hum level directly
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£210 0s. 0d.

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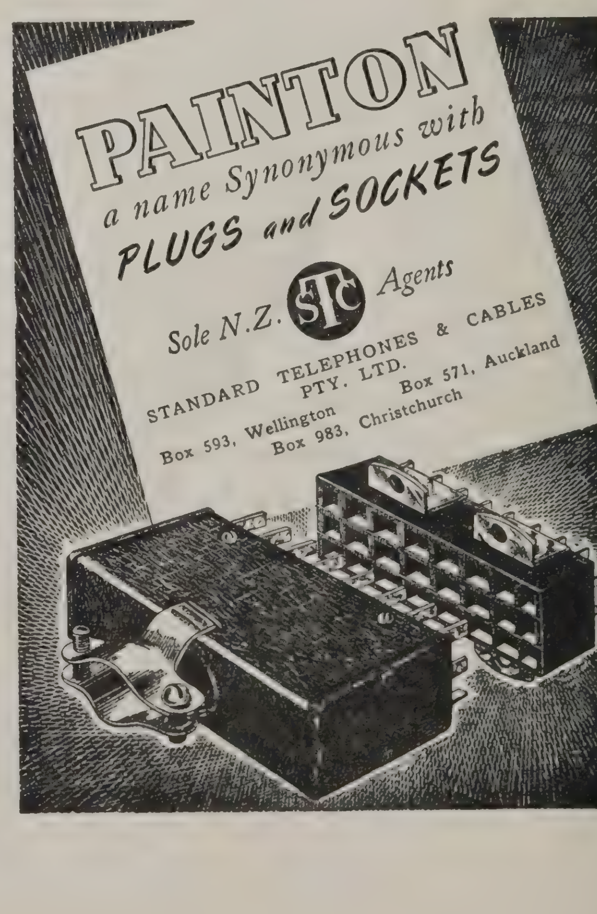
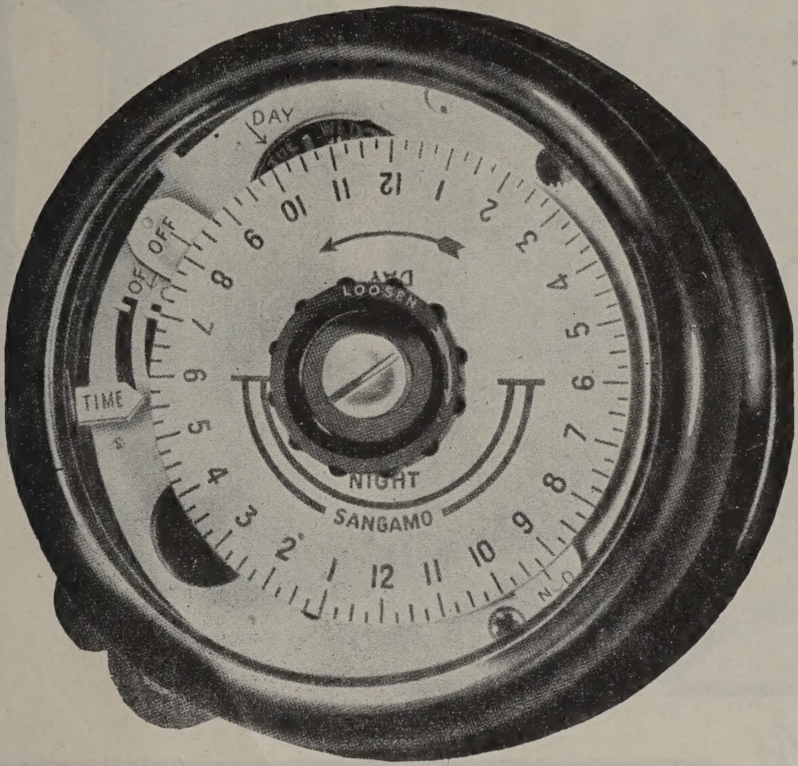


SANGAMO WESTON



TIME SWITCHES

SYNCHRONOUS and SPRING RESERVE

Sangamo Time Switches are now available with or without spring reserve. The spring reserve enables them to function for a period of at least 18 hours after interruption of electricity supply. When the supply is on, the mechanism is driven by the mainspring through an escapement, and this escapement is synchronously controlled. This synchronous control feature is patented and is one of the outstanding merits of the design ensuring absolute accuracy of timekeeping.

The mainspring is kept fully wound without the use of any slipping clutch device which could wear and become erratic. During supply interruptions, the switch continues to function, being driven by the mainspring controlled by the escapement.

Any spring reserve model is interchangeable with its corresponding standard synchronous model without the necessity for changing the base of the switch or the wiring. To accommodate the increased depth of the spring reserve model, a new cover is required.

Write for details of models available to:—

Sole New Zealand Agents **E. C. GOUGH LTD.**

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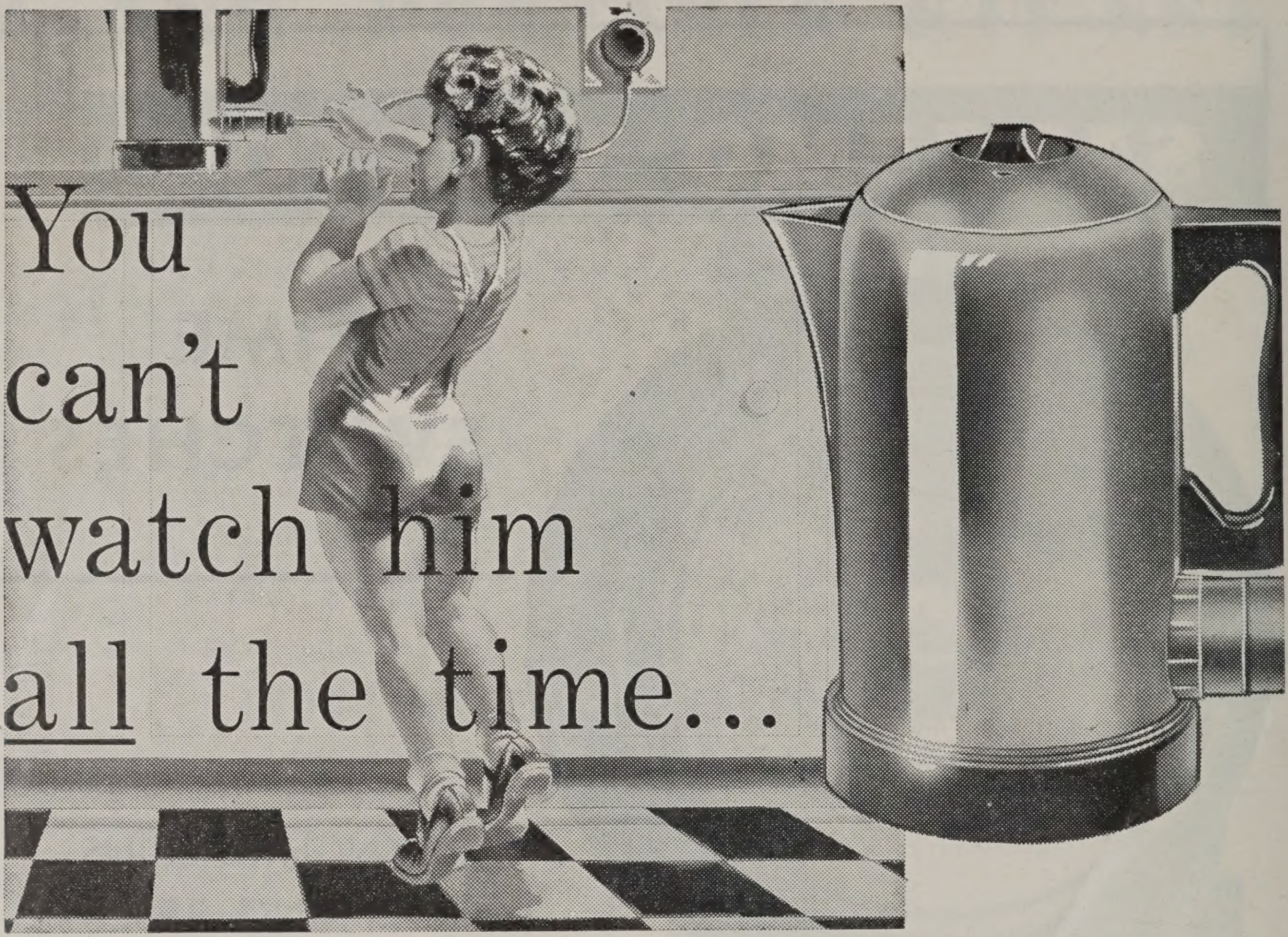

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